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THE MILKWEEDS.

BY JOSEPH F. JAMES, M.S.[1]

WHO is there that has not noticed the sticky, whitish juice which exudes on the breaking of the stem of the large and common Milkweed growing so plentifully in waste places and along roadsides? Who has not also noticed that neither horses nor cattle ever touch the plant? While the herbage all around will be closely cropped, often not a blade of grass left more than half an inch high, the Milkweed rears its head aloft in conscious pride of vantage. It well knows, apparently, that it is not acceptable to the animals grazing about it, and finds itself left to perfect its seed in peace and at leisure. It has, perhaps, seemed strange to observe that the plant is so little molested by cattle. It is, to be sure, rank and robust; but that is not a sufficient reason for being rejected. The great Horseweed grows higher and ranker, but is greedily eaten by horses; and many weeds, apparently as little palatable, are devoured. What is there about the Milkweed which gives it an advantage over the other plants of the field? In this, as in other cases, the common name tells the story; but it does not tell why the milky juice, from which it has received its name, is so abundant.

In spite of the platitudes about the peacefulness of nature, as contrasted with the warfare of mankind, no one can wander through woods and fields without coming, in a short time, to

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the conclusion that the warfare there is even more severe than it is with the human race. He will find that carnivorous animals devour others weaker than themselves; birds feed on grasshoppers and other insects; these again prey on others; and so the warfare continues down to the minute animalcule which can be seen only under the microscope, and which swallows other creatures only a little smaller than itself. Not only so, but he will find the Carnivora disputing with their own kind; wolves fighting with other wolves; birds contending with other birds for the insects they need; and these in their turn fighting their own kind for nearly every mouthful of food. Everywhere he will find war being waged continually; so that he must finally come to the conclusion that nature is far sterner than man in the struggle for the means of living.

Perhaps he may think that in the animal world alone this warfare is going on; but if he turns to the vegetable kingdom with the idea that here there can be no such struggle, a short time will convince him of his mistake. He will not, indeed, as a rule, see one plant devouring another in a literal sense; but he will find one sort of tree crowding and pushing another, or overshadowing smaller plants so that they cannot live; he will see them in the fields so close together that he soon concludes they must take more or less moisture and nutriment from each other; he will find the roots so crowded and matted together that the soil is a mass of them; that here one plant has fastened itself on another and is sucking its life away; and he will be forced at last to give a reluctant assent to the assertion that there is warfare among plants as there is among animals, and that the difference is one not of kind, but of degree. This constant, continual, fierce fight is the struggle for existence, in the course of which the fittest will survive. In other words, that plant or animal will be the most likely to live and continue to propagate its species which can best succeed in crowding out some of its competitors, and in taking the nourishment they need to itself.

It is for the purpose of carrying on this continual struggle that many structures have become developed. For instance, the lion has had his strength increased and his retractile claws sharpened by the constant effort he is obliged to make to conquer and carry off his prey. There can be no doubt but that

these claws have been acquired in the course of ages, being developed more and more fully as time went on. Neither can there be any doubt but that they are now necessary for his existence. So it is with all other weapons of defence or offence that have been developed by use. Their principal purpose has been to enable their possessor to live, and, as the strongest and the one best provided with good weapons is the one most likely to continue his kind, improvement goes on until a certain degree of perfection is attained, and the animal is fitted to a place which it holds against all competitors.

While adaptations of one kind arise among animals to enable them to compete with each other in this struggle, adaptations of another kind are developed in the plant world. These take the form of hairs on the stems and leaves; stronger modes of growth; climbing propensities; parasitic habits; the development of prickles or thorns; the formation of deleterious juices, unpleasant odors, or aromatic qualities. Others, again, place their chief reliance for continuing their species on the hard shell encasing their nuts or fruits, and, by producing these in enormous numbers, have an excellent chance of perpetuating themselves. All these have, it should be understood, been acquired by plants so they can hold their ground in the battle for life; and, consequently, those species best provided with means to resist the attacks of animals, either by being more unpalatable through disagreeable odors or tastes, or by having tougher or harder shells to the seeds, or by being aromatic, or in some other way, will stand the best chance of living long enough to perfect seed, and thus be the means of continuing their kind.

Each one of the many ways of resisting the attacks of animals has been only gradually acquired. From a small beginning, the importance of which is not at first to be perceived, the features have increased in usefulness and attained perfection only after many severely fought battles with hardy antagonists.

Perhaps one of the most effectual of all the modes of protection acquired by plants is to be found in the presence of a milky or colored juice. This is a character which is shared in common by a great number of species of widely different orders; but there is no species in which the milky juice is more conspicuous than in the Milkweed. While in various species of the Compositæ, such as the Dandelion, the Wild Lettuce, and the

Sow-Thistle, this juice is plainly seen; while in the Buttercup it is acrid, and in the Blood-root it is red, yet in none of these does it seem to serve the purpose so well as in the Milkweeds. It is not, either, confined to any one species, but is characteristic of most members of the order. The species number over thirteen hundred, are widely scattered over the world, and are most diversified in form and habit. Some of them are climbers, some creepers, some herbs of upright growth, some shrubs, and some trees. Two features which are found in many of them are the milky juice and the peculiar flowers. In the common Milkweed of this country (*Asclepias cornuti*) these peculiarities are seen better than in almost any other species. It is also well known that the plant will thrive in nearly every sort of situation; consequently it must possess some quality that gives it a better chance to grow than many other plants. The reason for its dominance is no other than the possession of its sticky, milky juice.

The sap of plants, though varying in different species, serves the same purpose in all. While primarily it is useful in one way, secondarily it may be beneficial in another; yet, not every plant possesses a sap of such service as that of the Milkweed. Serving as a vehicle for the conveyance of nourishment from the roots to the leaves, it carries with it at the same time such disagreeable properties that it becomes a better protection to the plant from enemies than all the thorns, prickles, or hairs that could be provided. In this plant, so copious and so distasteful has the sap become that it serves a most important purpose in its economy. The gradual development of this feature to its present state has been attended by certain changes in the flowers and fruit, which, together, make the family one of great interest; and when it is known that there are a great many plants which possess a milky sap, only not so well developed as in the Milkweeds, it is only necessary to carry the imagination back to a progenitor which possessed the slightest traces of this, and there is sufficient reason to look for its future perfection. In the fierce struggle which goes on constantly among plants, anything which is advantageous in the slightest degree is sure to be preserved; and as it is transmitted to the progeny, and by them sent on downwards, it will improve at every step. If, for example, the plant becomes disagreeable to the animal grazing in its vicinity,

it will be left alone just as long as there is anything else to be found. Should there come a favorable season, with an abundant vegetation and good grazing, such plants will then have an excellent chance of perfecting seed. Even during a season when plant-life must struggle for water, and when herbivorous animals greedily devour everything they can find, the milky-juiced plant will succeed better than any other, because it will be the last one to be touched. Thus from generation to generation the development will go on, until it reaches a state which requires no further change, and it then remains quiescent. Having, however, once acquired a feature, it will be a long time, indeed, before it will lose it. In the present instance the flowers seem to have been developing in their way, while the juice pursued its own.

The flowers of the common species are produced in large clusters, are pink in color, and have quite a perceptible odor. They are visited by insects in great numbers, as many as thirty-one different species having been counted; and this fact shows they possess considerable attractive qualities. If we examine an individual flower of a cluster, a peculiarly complicated mechanism will be revealed. The two floral envelopes, calyx and corolla, are folded back or reflexed on the stem. Inside of these is a column made up of five sac-like bodies, each

FIG. 1.—Flower of *Asclepias* enlarged.

FIG. 2.—Sac in which the pollinium is lodged.

FIG. 3.—Hood, with horn.

crowned by a horn-like process. These seem to be nectaries, where honey is secreted. Between the nectaries there is found, on examination, a peculiar slit, wider below than above. At the upper end is a hard, thin lamina, or blade, with the sides bent inwards so that the edges are close together. In swollen sacs

on each side of the slit the pollen-grains are found. The peculiar feature of these grains is that they are united into masses

FIG. 4.—Pollen-masses of *Asclepias* hanging by twisted appendages and fastened to the gland above.

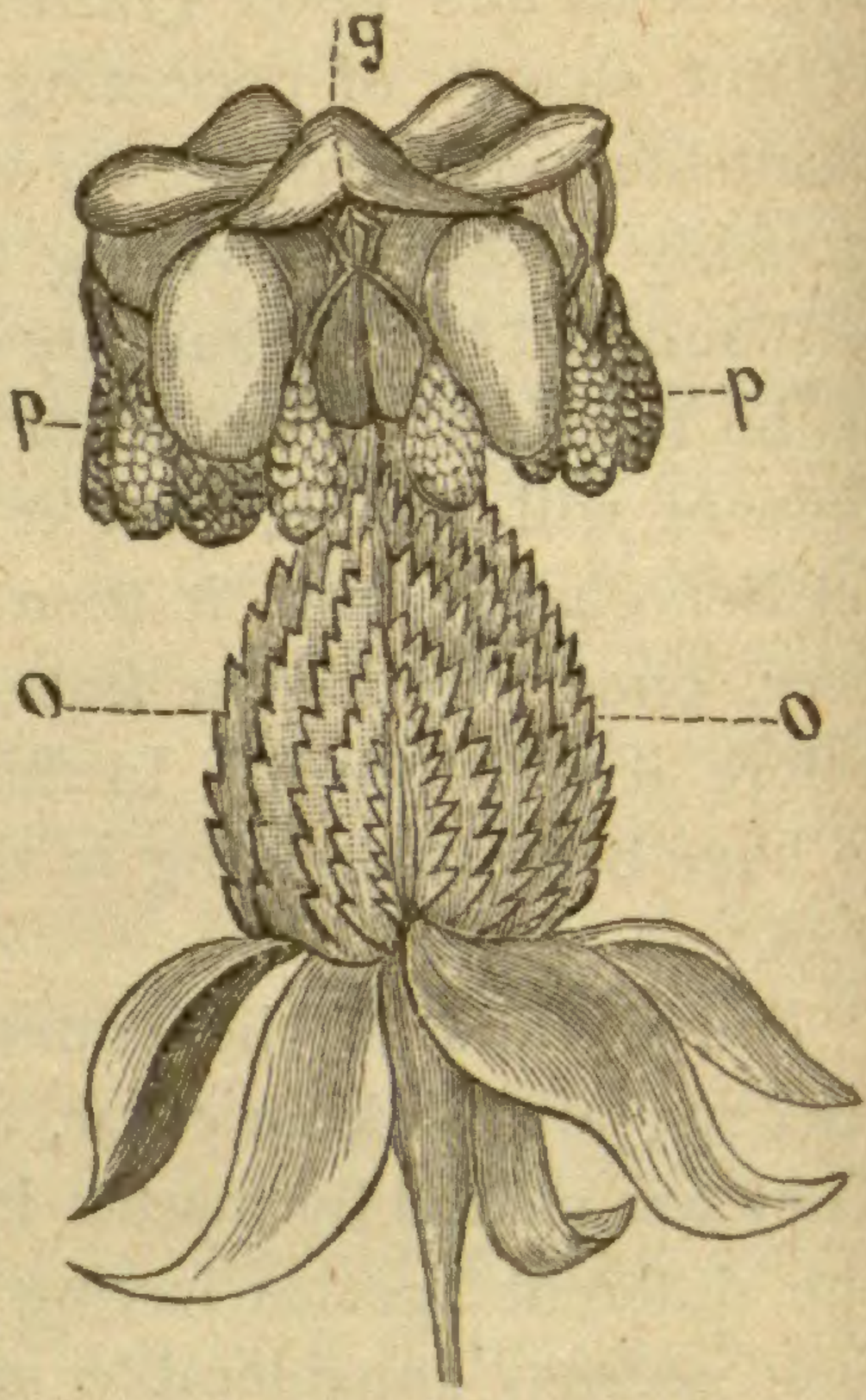


FIG. 5.—Flower with hoods cut away, showing ovaries (*o*), the pollinia (*p*), and the slit or gland (*g*) uniting two of the pollinia.

or clusters, the individual grains held together by sticky threads, —a feature found in only one other family. The stigma surmounts the two ovaries like a large cap, and is placed immediately in the centre of the column, with the pollen-sacs arranged around the outside. To enable the pollen to reach the stigma the pollinium must be taken out of the sac where it hangs and be inserted into the slit between the nectaries. This can only be effected through the agency of insects, and these perform the service in the following manner:

The visitor, attracted by the odor, alights to suck the nectar secreted in the hoods. In its progress over the blossom some one of the hairs of its legs is sure to slide into the slit between the hoods. Pursuing his way by drawing up his leg, the hair will be guided by two flanges at the sides into the upper and narrower part of the slit, and there become fast. Feeling a detention, the captive will pull to release himself, and, if possessed of sufficient force, will bring out of the sacs at the sides two pear-shaped pollinia, each fastened to the lamina, or gland, by a short appendage (see figure). When they are first withdrawn the pollinia are divergent. In a comparatively short space of time the appendages begin to twist, and then the pollen-masses are brought close together; not, however, before the insect to

which they are attached has had time to fly to another flower. On reaching this new flower the hair bearing the pollen will be guided into the slit, and, too large to be drawn through, will be detached, and so left in the exact position to send the pollen-tubes into the stigma.

Insects visiting the flowers often have cause to rue the visit. Honey-bees have often been found dead, with many pairs of glands or pollen-masses attached to them; for, visiting the flowers and extracting numbers of the masses, they become entangled, and finally perish of starvation. One entomologist, having found a beetle with many pairs of stalks and pollinia upon the hairs of its tarsi, sent a drawing of it to a scientific journal, and referred to it as possessing peculiar appendages, the like of which he had not before seen, and which he supposed to belong really to the hairs to which they adhered. But it was soon pointed out that, instead of natural appendages, they were those acquired in peregrinations over clusters of Milkweed blossoms.

FIG 6.—Leg of beetle, with pollinia attached to the hairs.

Notwithstanding the numbers of insects frequenting the flowers, it is noticeable that only a few of them produce seed; for the pollen-masses *must* be removed from the sacs and *must* be inserted into the slits before the stigma can be fertilized. Sometimes, it is true, the grains, while yet in the sacs, send tubes into the stigmas; but these tubes are inoperative, and do not enable the flower to set a pod. It is quite rare to find more than two pods produced out of a bunch of, perhaps, fifty flowers; and often there will be only one or two pods on the whole plant. But what the plant lacks in the number of pods it makes up in the number of seeds found in each one. These seeds are packed so closely and tightly together that a single pod contains an immense number. They are provided, too, with such an admirable appendage for being wafted through the air, and this serves its purpose so effectually, that even a few pods are sufficient to stock a large tract of country.

The peculiar arrangement of the pollen-grains in masses is

something which is found in but one other family. This is the Orchid family. In this order the peculiarity has been more fully developed than in the first one, and the differentiation is greater. Ordinarily in the Orchids the caudicle, or stem, contracts and bends the pollinium forward; in the Asclepiads the appendage twists in drying, and the two pollinia are then brought close together. In both cases the pollen-grains are only then in a position to reach the stigma. Darwin has demonstrated that the contraction of the caudicle of the Orchid pollinium is necessary to prevent its being put back into a cell similar to the one from which it was taken. In the Asclepiads the twisting of the appendage brings the two pendent pollen-masses together, and enables them to slip into the slit between the hoods, and be thus in a position to reach the stigma.

FIG. 7.—Pollinium of *Orchis*.

The appendage to the seed of the Milkweed is of the same character as that found in the Dandelion, the Thistle, and many other plants. In all it serves the same end. But in some species of the family the coma has the peculiarity of expanding very rapidly on exposure to the air. In one of these (*Gonolobus obliquus*) it is recorded by Mr. Meehan that the expansion of the coma is so rapid as to be compared to a stroke of lightning. He says it is followed by the eye with difficulty. While one instant it is enclosed in the capsule closely packed away, as soon as it is exposed the hairs of the coma fly round and form a perfect hemisphere. This is a necessity, because if it did not so occur, the seeds, being heavy, would fall to the ground close to the parent plant, and the purpose of the development of the feathery appendage would be defeated; but, drying so rapidly, they are in a condition to be carried by the lightest wind to great distances.

While in the common Milkweed the milky juice of the stem is so abundantly developed, it is a little remarkable that in another species (the Pleurisy Root) it is entirely wanting. The flowers are similar, and the sap is so acrid as to cause the plant to be rejected by all animals. It grows in very poor soil, and has but few plants to contend with; so that the acridity serves to protect it in much the same way as if it had a milky juice.

The sixty or more species of Asclepias are, with two exceptions, confined to the American continent, and the amount of milky juice varies in the different species. The acridity of those species which have no milky juice is a sufficient protection, however, from the attacks of herbivorous animals.

Other genera of the order present, in their turn, various features of interest. *Stapelia* is a genus of about one hundred species, all of them found in the Cape of Good Hope region. They are peculiar in having thick, fleshy stems, generally with small scales in place of leaves borne on the angles of the stems. The flowers are mainly star-shaped, starting out at various points on the stem, and are remarkable for their disagreeable, carrion-like odor. This is so marked in certain species that it attracts large numbers of flies. These sometimes lay their eggs in the flowers, but the progeny, when hatched, die for want of food. The main object of the odor of the flower is to attract insects for the purpose of fertilizing it by the transfer of pollen from one plant to another. About the centre of the flower are certain black spots, which are peculiarly attractive to insects. In one species (*S. asterias*) flies have been observed to feed greedily about these spots, and it is found that the fly's tongue often gets caught in a trap situated hereabouts. When thus caught it struggles violently to escape, and, if successful, goes away with a pair of pollinia attached to its tongue, drawn from their enclosing sacs. The apparatus which catches the tongue is a veritable spring-trap, closing with a snap on the intrusion of any disturbing object. The insect, laden with the pair of pollen-masses, flies to another flower, and there places them in a position where the pollen-tubes can penetrate the stigma. Here, then, there are three interesting features to be noted,—first, the thick, succulent, leafless stems, which enable the plants to exist in dry, sandy soil, and, at the same time, furnish no inducement to any stray animal to feed upon; second, the carrion-scented flowers, which attract flies, necessary for the fertilization of the stigma; and, third, a veritable spring-trap, which catches the tongue of the little carrier, so that it flies away with the pollinia to another flower, and effects cross-fertilization.

The succulent stem may be regarded as developed because of the necessity to retain a supply of moisture in the dry, arid regions, whither the plants have probably been driven from an

inability to cope with more vigorous forms of vegetation. The scent of the flowers has been acquired to enable insects to detect the presence of the plant at a distance, while the spring-trap was a necessary contrivance to certainly secure the transferrence of the pollen from one plant to another.

Besides the genera *Asclepias* and *Stapelia*, there are others which possess points of interest, or are valuable in a commercial sense. The species of the genus *Hoya* have climbing stems, thick, succulent leaves, and clusters of waxy flowers. Hence the common name of wax-plant. Various species are cultivated, and are great favorites because of their fragrance and beauty. It is stated that the young leaves are used by the natives of Ceylon in their curries; and one curious feature of the plant is that the flowers come from the same bud year after year.

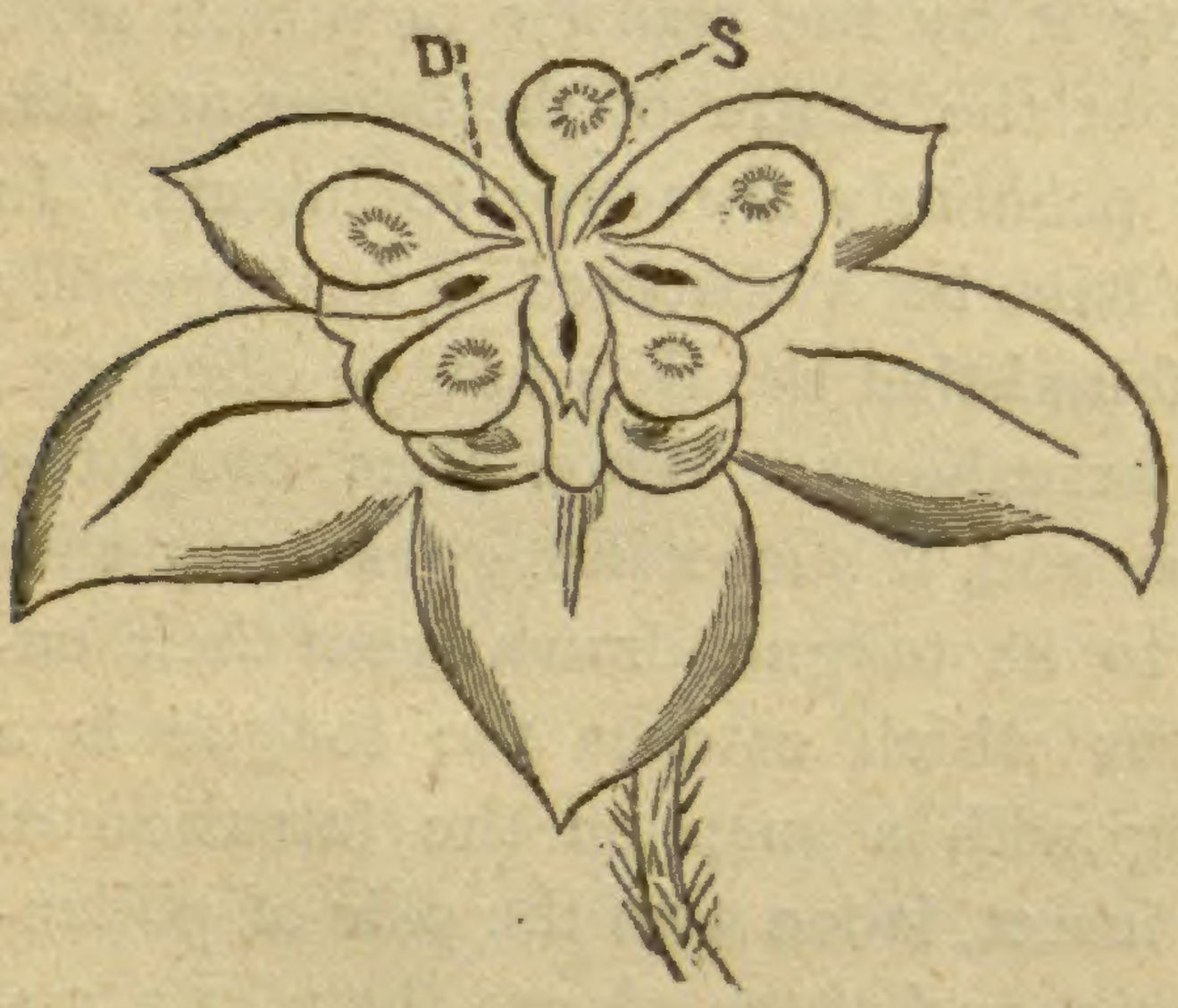


FIG. 8.—Flower of *Hoya*. S, stigmas; D, disks of pollinia.

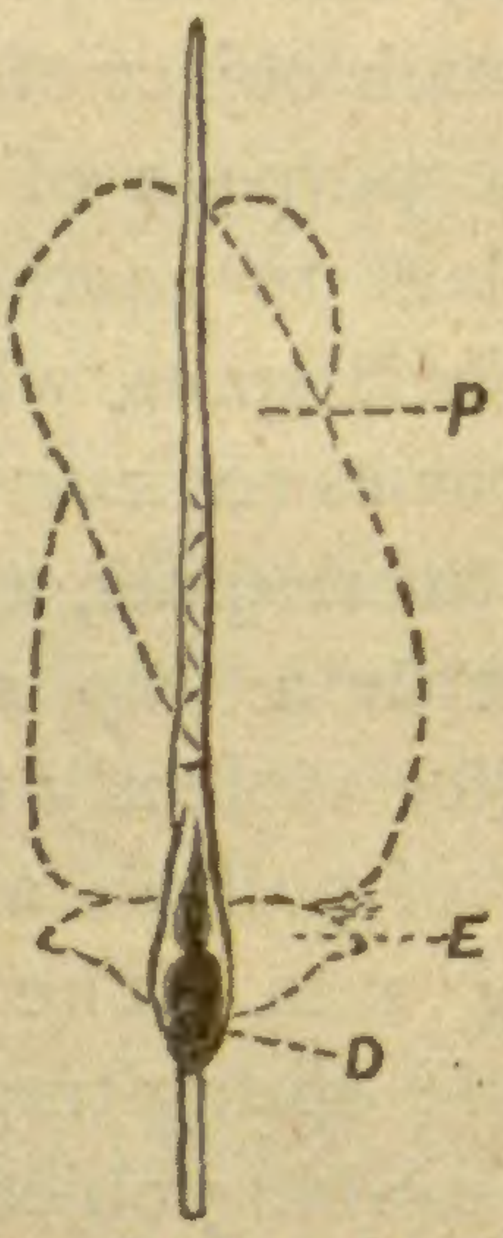


FIG. 9.—Disk and pollinia. P, pollinia; E, elastic appendage; D, disk.

The fertilization of *Hoya globulosa* possesses points of interest, the mechanism being much the same as in Asclepias. It has been described in the *Gardeners' Chronicle* for April 29, 1882, by Mr. W. G. Smith, as follows: The flowers are regular, grow in clusters, and are very fragrant. The pollen-grains are united in clusters and enclosed in pouches, five in number. The glutinous, dark-colored disks of the pollinia are the only parts of the stamens visible in an open flower. If an insect, attracted by the fragrance, alights on a flower, it almost invariably happens that one foot slips and is caught by one of the sticky disks. Some-

times four feet are entangled, and then ensues a struggle to escape. If strong enough, the fly tears itself away, but in the effort takes the pollinia attached to its feet along with it. "The basal appendages of each pair of pollen-masses," says Mr. Smith, "are elastic, and when in the pouch they are like an extended spring, but the instant the masses are drawn out by the insect's foot the spring closes, the two pollen-masses quickly cross each other and hold tightly on to the insect's little claws." The stigmas of the flower are exposed in the centre of the parts forming the apex of stamens and pistils, and these are not ripe at the same time as the pollen. It is therefore necessary for the pollinia to be withdrawn from the pouches and conveyed by the insect to another flower in which the stigmas are ripe before fertilization can take place.

Other species of the family are noted for their medicinal properties. For example, one known as *Tylophora asthmatica*, or Indian Ipecacuanha, is largely used in cases of dysentery. Others are valued for their fibre. One of these is *Calotropidis* (*Asclepias*) *gigantea*. This is spun into the finest thread for sewing or weaving. Handkerchiefs made from it were shown in one of the Paris exhibitions. A species in our own country, very common in wet or damp places (*Asclepias incarnata*), produces a long, tough fibre which could be used for many purposes. Another species (*Marsdenia tenacissima*) produces fibre so strong that the natives of some parts of India use it for bow-strings. The stems are dried in the sun, and the milky juice which exudes hardens into a substance like india-rubber; and there are other species in which this juice could be used for many of the purposes to which caoutchouc is now applied.

It is thus seen that the family of Milkweeds is useful practically, as well as interesting botanically. We use the sap in our way as the plant uses it in its own. The same tough fibre which makes the plant disagreeable to animals the human race finds useful to itself. The same sweet-scented flowers which attract swarms of insects delight us in our greenhouses; and the same curious forms of stems adapted to a plant's existence in dry and arid regions form curious features in the homes of civilized man.

METHODS OF INSTRUCTION IN GENERAL GEOLOGY.[1]

BY H. S. WILLIAMS.

WHAT I can offer on this subject must be confined to a few suggestions upon points in which I see need of improvement, and some account of the various ways in which I am attempting to apply scientific method to the teaching of geology at Cornell University.

The science of geology, like the earth, from which it derives its name, bears a kind of maternal relation to the kindred sciences. As the materials discussed by physics, chemistry, and even biology come out of the earth, so the sciences treating of them have their springs of origin, and have been separated off from that more general science now represented by geology alone. As the more exact sciences have become organized they have set up their own standards and their own more precise methods, while geology has not become quite freed from some of the ancient crudities and myths.

This peculiar relation borne by geology to kindred sciences has much to do with the peculiarities of the methods in teaching it. Geology is less exact; there are more unsolved problems, or problems the solution of which is recognized as tentative; there are more points of contact with the dark regions of the unknown than are found in the other more specialized sciences.

This doubtless arises from the fact that as human knowledge has grown and the problems have become more scientifically interpreted, and the ultimate laws have been discovered, the principles involved have been relegated to their more special branches,—to physics, to chemistry, to astronomy, or to biology.

On the other hand, when these more precise sciences come across vexatious questions too complex for either alone to handle, they toss them into the broad lap of geology, so that we are left with the more mysterious and inexplicable phenomena of nature to wrestle with as best we may.

This broad and fundamental nature of the subject-matter of

[1] Delivered at the meeting of the American Society of Naturalists, at Philadelphia, December 29, 1886.

geology tempts a superficial treatment, and the teacher of geology needs to be specially on his guard lest he fall into the discussion of mere generalities. When we discuss the principles of geology we must generalize more or less. The facts are so many and so various that it is necessary to state in condensed form the laws which may best express the characteristics common to a great number of facts or phenomena. But when the geologist generalizes he is in greater danger than teachers of other sciences of being tempted to sacrifice science to the popular interest in wonders and curiosities.

The intimate relation borne by geology to the other sciences demands a broader knowledge than is required in them.

The geologist must apply to the solution of his riddles the laws of physics, astronomy, chemistry, biology, and mineralogy, and this brings with it the temptation to confine his instruction to the announcement of the theories, while referring the student to the special science concerned for the real solution of his problems.

Again, we may observe that geology, lying between the more thoroughly specialized sciences of modern times and the philosophies and purer literary branches of learning, has not altogether lost the effects of the scholastic methods of the literary school, nor has it fully attained the perfections of the scientific school.

Literary scholarship has for its ideals the skilful use of language as a means of expressing thought, of thinking and of interpreting thought. The subject-matter of this scholarship, as we scientists look at it, is language, and therefore the learning or mere memorizing of words and forms of verbal expression, including terse formulas and abstract statements, is valuable in itself, and is directly in the line of attainment of that kind of skill sought after in literary study. But verbal expression and definition is of secondary importance to the scientific scholar. To know simply names and definitions, laws, and, I may add, statistics, without the discriminative power of the eye, or ear, or touch, does not make a scientist. This acquirement bears no closer relation to scientific knowledge than the reading of an English translation of Cæsar's Commentaries bears to a knowledge of Latin. We would never think of calling him a classical scholar who was unable to read the original text. No more should we regard him a geologist,

however well he might remember the text-book definition, who is unable to recognize and interpret geological phenomena in nature,—in the field and laboratory. Hence, in teaching geology, the mere ability to talk *about* geology, to say that Paradoxides is characteristic of the Cambrian, that Ichthyosaurus is a Mesozoic reptile, and a thousand other similar items of geological information, is of little or no practical use unless the student is taught to recognize an unlabelled Paradoxides when he sees it, and would know how to distinguish Cambrian rocks in the field. The subject-matter for the scientific scholar to acquire is found in the things and phenomena named and described, and not in the names or definitions.

In other words, the methods of literary instruction are of but limited value in teaching geology, and although we may begin with these methods, the teacher should not deceive himself with supposing that he is teaching science, or that the student is learning science, unless the lectures and text-book work are supplemented by drill in the laboratory and field. It may seem more dignified to stand up in a lecture-room before a lot of students and read off a lecture on geology, but the best results will come from the tramps and the hammerings in the ravines and railroad cuts and the study of hand specimens in the laboratory.

Our lectures may inspire the students to study, but most of what they learn will come by other methods.

We are obliged to use the lecture method, although not the ideal way of teaching science, on account of the large size of classes in our universities. Quizzes, and these written after every five or six lectures, I find of value in calling out study and thought upon the topics discussed in the lectures, and these I believe should always supplement the lecture for the best results.

In the lecture method there is one danger not met with when a good text-book is made the basis of recitations. Unless the lecturer is on his guard he will forget that his pupils are beginners, and neglect to state the essential details needed for a clear understanding of the topics under discussion. These details, when crowded by the multitude of topics he is tempted to consider, will be omitted by the lecturer because they seem to him so familiar.

To ward against this evil I give references to the pages in

the more common text-books on geology, where the student may study more explicitly the subject lectured upon. I expect, too, that the student, who will acquire any exact knowledge of the science, must give some time both to this kind of book study and to the examination of specimens arranged and labelled specially to illustrate the facts discussed.

Again, it is important to so accentuate the lectures that the grand and important lessons shall not be smothered and quite lost to sight by the innumerable names and definitions and topics with which the lecture is necessarily filled. For I hold that, in teaching a class of ordinary college students general geology, it is far more important to teach them how to treat geological problems, what the grand questions are which the geologist meets, and the right methods of attacking, of thinking about, of interpreting them, than to teach definitions, technical formulas, or lists of associated facts.

The latter are all essential for the real geologist to master, but not in the lecture-room. They must be acquired by patient study of the more exhaustive manuals and original reports, and by actual laboratory and field practice.

The work for the lecturer upon general geology is to clearly present the principles of geology, to illustrate and explain the grand features of the science. He must teach what the science treats about, what and where the problems are exhibited, how they are explained, and what laws underlie the phenomena.

While the student gathers enough to excite his interest and enthusiasm, if possible, the method of stating the facts and theories should be such as to enable him to appreciate what there is to learn, rather than to convey any notion that he is getting from the lectures a knowledge of all the essential facts of geology.

We may be able in our lectures to teach the student the alphabet, so to speak, of the science, or even to teach him how to spell or frame sentences in terms of the geological language. We may succeed in showing him how to investigate and interpret geological problems. But I take it to be of essential importance to impress upon the student that the lectures are but an introduction, that the true place to learn geology is in the field and laboratory, and the true method, that of studying over in detail individual phenomena and facts.

This is not generalizing or popularizing the subject; it is making the lectures a means of scientific training, instead of allowing them to degenerate into a glowing account of the wonders of geology.

Geology may truly be a popular subject, because of the many remarkable events and phenomena it reveals, but it is not the remarkable, the unique, and the impressive facts of geology that are the most instructive.

The awful eruption that throws out lava and ashes from a volcanic vent, or tears off the top of a volcanic cone, is not so direct an illustration of the peculiarity of vulcanism as the little bubbles which puff up the cooling lava and testify to the presence of expansive vapors or gases in association with the molten condition of the rock.

The grand cañons of the plateau district are not so valuable as illustrations of the laws of river erosion as a simple rocky ravine composed of a few strata of alternating hard and soft strata, or even the rill along the roadside after a heavy shower. But, after having once grasped the principles of river erosion, its slowness of action, the smallness of the effect in proportion to the amount of water traversing the gorge, then the cañon does become an impressive illustration of the continuity of geologic dynamics over vast periods of time,—of the immensity of deposition of sediments,—of the grand results effected by the slow elevation of continents,—and it serves to convey some conception of the length of actual time with which the geologist has to deal.

Improvement may be made in the order of presentation of the topics.

In our standard text-books we frequently find what I may call the scholastic method followed,—a method which proceeds from the announcement of principles, laws, or technical definitions to the descriptions or illustrations of facts from which they have been drawn.

As an illustration the following may be taken from chapter second of Dana's Manual. The subject is lithological geology. First we are given a brief classification of the subject, then the definition of rock; then follow three sections in the following order: 1st, the elements constituting rocks; 2d, the mineral materials constituting rocks; 3d, the kinds of rocks.

For a geologist familiar with the general subject, and as a book of information arranged for ready reference, this is as good an arrangement as could be desired. But when the science is presented for the first time to the student, is this the order in which he must grasp the details of the subject for clear comprehension? I think not.

And why is it unnatural? Because the student is asked to take the results of an analysis before he is presented with the conception of the thing analyzed. He is led to form a synthetic conception of the objects studied, built up of definitions, rather than by analysis to increase his knowledge of the object by viewing it in new relations.

Rocks are at first parts of the earth, and among themselves they first differ in their physical relations of position, structure, form, and composition. The chemical and mineral properties are secondary in order of analysis; and the microscopic appearances presented by separate mineral species constitute a tertiary set of characters.

The teacher should have regard to this order of acquisition, although, after having named and briefly described the terms, they may become for his purposes mere definitive terms with which to describe the more comprehensive laws of the earth's formation.

For this reason there is propriety in uniting physiographic, structural, and dynamical geology as a first division of the general treatment of geology, following with the stratigraphical and palæontological part as a second division.

This plan, substantially, is followed in several of the more widely used text-books, as Phillip's, Credner's, Geikie's, Le-conte's, and others.

In determining the order of presentation of the facts for particular cases, I examine the order in which the facts naturally develop in the process of investigation. As a general statement of what this order is, I find it to be from the more conspicuous, the more easily grasped, and the simpler, to the less evident, the intricate, and the fundamental. This same regard to the order of acquisition of ideas is applicable to the methods of illustration.

Every teacher of natural history has more or less use for diagrams, but I have thought that blackboard sketches, although crude, made while the explanation is going on, are often more

effective in imparting the information desired than the more finished ready-made diagrams. The value of the blackboard sketch is in the fact that it emphasizes your words, makes them more vivid and expressive; with crayon in hand as you talk, the lines of the sketch become a kind of lineal gesture.

This result is particularly seen when the relations of two or more objects are expressed, or when serial or gradual changes or developments are considered, as in explaining Darwin's theory of the formation of coral reefs and islands, or the structure and growth of a common volcanic cone, or the effects of erosion in cutting through a series of hard and soft stratified rocks, and the relation of dykes to eruptive sheets, to volcanic lava-beds or fissure lava-fields.

All such phenomena are more vividly expressed to the beginner by blackboard sketches than by the more perfect diagram, and the reasons seem to lie in the fact that the student only appreciates the points to which his attention is definitely called; the large number of details expressed in the finished drawing tend to divert his thought from the essential few which are brought specially under consideration.

In teaching palæontology, in comparing genera, in pointing out variations and the relations of one form to another, I find the blackboard a great assistance.

A method specially successful of late in the teaching of biology suggests lines of improvement for the teaching of geology. The method I refer to may be called the exhaustive study of types, and such a book as Huxley's "Crayfish" may illustrate its application.

The secret of the value of this method lies in the process of taking a single object for minute and exhaustive study, examining it in all its several relations,—turning it around and throwing light upon it from every side, until the one thing is thoroughly understood in its every relation. The one object thus becomes a familiar and typical example of all the principles involved in its structure, function, or other relations. Afterwards, the widening of one's knowledge becomes a simple and also a systematic mental noting of likenesses and differences. The knowledge thus acquired, instead of being vague and general, becomes positive and precise.

In applying this method to teaching geology, I select a few

characteristic phenomena, describe them particularly, noticing the individual details, and endeavor to make the one case thoroughly understood in all its important relations, so that it becomes the illustration of the several principles involved.

Thus, in explaining volcanoes, instead of spending the time with an enumeration of statistics and formulæ, crowding the lecture with all the information possible about volcanoes, the whole lecture may be spent upon Vesuvius, its environs and history, making vivid impression of one or two typical eruptions, and, by the aid of maps of the region, pointing out the precise phenomena in the locality, sequence and results in building a cone and making volcanic deposits. With a clear notion of one such typical volcano, it is a simple matter to classify and point out the kinds of volcanoes,—the pure tufa eruption, as at Monte Nuova, the continuous lava flow, as in the Sandwich Islands,—and by means of the grand eruptions recorded of Skaptar Jokul, to gain a conception of fissure eruptions and the nature of the vast lava-fields covering now such large tracts of the surface, but without the conical mountain peaks which we naturally associate with igneous eruptions.

In the same way in treating of river dynamics, instead of brief descriptions of the great rivers of the globe, the amount of their erosion and sedimentation, the volume and rate of their water-flow, etc., presenting a great number of condensed statistics about many rivers, a better way is to spend the time in explaining the facts and their interrelations for a single typical river.

No better example can be found for us than our great river Mississippi, so thoroughly studied and reported upon in Humphrey and Abbott's monograph. For illustration of the principles of erosion a familiar ravine, near by, is better than a large river-gorge at a distance. Niagara may well serve to illustrate the rate of erosion and as a short measure of geologic time. The cañons of the plateau district are illustrative of the laws of continuous depositions, of slow but great elevation, and furnish a longer but conceivable measure of time for geologic events.

So in all cases, where it is possible, selection should be made of a familiar and typical example, and around it should be gathered the details of facts and phenomena which will illustrate the principles discussed. By communicating a clear, detailed conception of the one example, the indistinctness and

often bewilderment arising from the array of a multitude of statistics in regard to many examples is avoided.

At first sight this method may appear like a mere popularizing of a science, and—the aspect which might be so called,—the attempt to make comprehensible and therefore interesting, what is generally not so, is worth seeking after.

Is it not this very element of exciting interest, of pleasing the hearers or readers, that made the writings of Lyell and the lectures of Louïs Agassiz so attractive and also so instructive?

The boys in college learn the principles of geology in the same way that we learn new laws and principles in our deeper investigations. It is facts and phenomena first, afterwards their interpretation; and unless they gain a vivid impression of the former, they will come short of grasping the latter. The other method of memorizing the statements of the laws and principles of the science, without any clear conception of the facts to which they apply, is only a knowledge of words; it is not science; and such knowledge has no scientific value.

In *field* and *laboratory* work the main point is to teach the student to observe, to record, and properly to interpret facts as they occur in nature. This is not accomplished by simply walking over the ground and pointing out the phenomena to the class. In one way and another they must be led to see for themselves; they must gather the facts, study and arrange them. The teacher may show them how to make sections, and how to gather facts and specimens. Section after section may be made through similar series; geographical localities, altitude, thickness, dip, lithological character, and fossils should be observed, and notes and materials brought in for study. After numerous sections are thus in hand, my plan is to call for a report upon the region or formations examined, asking for detailed answers to the questions, What are the faunas? What are the differences in the several sections? What changes are seen in the nature of the deposits on passing upwards? What are the names and characters of the individual species? etc. If the student wishes to perfect himself in palæontology, I set him at work on the local palæontology and stratigraphy, causing him to make comparison of sections, of association of species and individual variations, as well as drilling him in the identifying of genera and species; using the local facts, because I find better results from the

deep and exhaustive study of what is at hand and is capable of such exhaustive treatment than is possible by the method of discursive rambling over a greater number of facts.

The materials ready at hand for us at Cornell University are Devonian; but the student who has learned accurately to identify species of a Devonian fauna has learned the relative importance of characters for classification; has learned the nature of variability, the relation of species to geological horizon, the modification of specific types with retention of generic features on passing from zone to zone; has studied the range and distribution of the species; has gained a conception of what faunal association is and how it is related to the lithological character of the deposits; I say the man who has grasped these details of the science by the use of Devonian material alone is ready to undertake investigations in any geological period, from the Cambrian to the Tertiary. The facts may differ, but the methods of research will be the same; and this method and skill cannot be attained by any amount of the mere memorizing of the names of a labelled collection of fossils.

It is a mistaken view to imagine that that kind of acquirement which only removes the Megatherium, the Ichthyosaurus, the Trilobite, and the Palæoniscus from the region of wonderland to a place among the things we have seen, is geology. So long as we use our museums as curiosity-shops and cover our ignorance with Latin nomenclature, we cannot expect to lift our science out of the region of crudities.

There is, however, some value to be derived from studying over labelled collections, but this must not be without the study of the fossils as they occur in the rocks, and the determining of the characters, the names, and the horizon, each man for himself.

And if the rocks are crystalline and not fossiliferous, this determines beforehand that there are not present the best facilities for the study of palæontology, although great museums may have been accumulated.

The natural rock foundations of the region in which a university is built thus decide the particular part of geological science which may be there taught most successfully.

To this fact may be traced the explanation why Harvard, Yale, and Amherst have been so prolific in physical geologists and mineralogists; why New York State has given us so many palæ-

ontologists; why the geologists of Pennsylvania have taught us so much about stratigraphy and the structure and products below the surface.

In each institution the natural advantages found in the accessible rock exposures of the region should be not only carefully studied, but should be made a prominent feature in all the advanced work of the college.

In conclusion, I would remark that (*a*) the fundamental nature of the subject-matter of geology, with its many still unsolved problems, its many mysteries, its many unique and wonderful facts, will tempt the instructor to deal with generalities, to rest satisfied with a superficial rather than a scientific presentation of his subject. As a means of escaping this danger I suggest a careful attention to the natural order of the acquisition of the facts,—a following of the analytical order, from the conspicuous, the evident, the general, to the special, the hidden, the individual, or, to use another form of expression, follow the order of induction from the concrete, the typical, the illustrative, to the principles involved to the formulation of the laws of nature.

(*b*) Further, I would suggest the great value of selecting a single typical illustration of each general principle, presenting it with considerable attention to details, pointing out its specific characteristics. This example, then, may be adopted as a standard for comparison with other cases which offer modification of the laws involved in the first typical case.

(*c*) In field and laboratory work the same method may be applied with good results. In this part of the study problems which are accessible, in which the student can investigate the details and gather numerous statistics mutually bearing upon each other, are to be selected. In this way the region in which he studies becomes one of the chief factors in developing his powers of investigation and in showing him how to interpret nature. He thus studies nature from the original text, instead of reading merely the translations made by others.

(*d*) In all the various departments of the science I would seek to teach the student precision and definiteness in his knowledge, and accuracy in his modes of thought, by applying the simple rule of teaching much about a few things, instead of attempting to say a little about a great many things.

THE RANGE OF VARIATIÓN OF THE HUMAN SHOULDER-BLADE.

BY THOMAS DWIGHT, M.D.[1]

THE late Professor Broca read a paper before La Société d'Anthropologie in 1878[2] in which he described the scapular and the infra-spinous indices, and proposed them as methods of ethnological research. Briefly stated, the scapular index is the proportion of the breadth of the scapula, measured along the base of the spine, to the length, the latter being considered one hundred. The infra-spinous index is the proportion of the breadth to the length of the infra-spinous fossa, the latter being considered one hundred.

The human scapula being the starting-point, Broca understands by "length" the line connecting the highest and lowest points, although in almost all mammals this is not the longest dimension. The line showing the breadth being called AB and that of the length CD, the index is obtained by calculating $\frac{100 \times AB}{CD}$. The length very rarely coincides with the posterior border of the scapula, but runs some distance before it. The line AD representing the infra-spinous length runs from the posterior end of AB to the lower end of CD. The infra-spinous index is represented[3] by the fraction $\frac{100 \times AB}{AD}$. Professor Broca used these indices both in comparative anatomy and in the study of characteristics of race, sex, and age in man.

In all orders of mammals, with one exception, the scapular index is greater than in man. In quadrupeds it is evident that the long diameter of the bone should at least approximately coincide with the line of pressure, and consequently we find the breadth—*i.e*, the line along the base of the spine—the longer. In erect man, with his great range of movement of the anterior extremities, there is need of greater leverage for the movements of the scapula, and less need of resistance to pressure, so we find a long and narrow scapula. This condition is approached in the anthropoid apes, and even surpassed in the bats, who have a

[1] Parkman Professor of Anatomy at Harvard University.

[2] Bulletins de la Société d'Anthropologie de Paris, série 3, tome i.

[3] By a most unfortunate oversight the AB and AD are transposed in Broca's paper.

lower scapular index than man. Broca's observations on the characteristics of sex and race of human scapulæ are by no means satisfactory, owing to the small number of observations. The indices of adult Frenchmen were obtained from twenty-three individuals, of which nine were female; and those of African negroes from twenty-five individuals, of which five were female. Apparently one scapula was measured in each case.

The next year Professor Flower and Dr. Garson measured two hundred scapulæ of Europeans. They admit that it is quite possible that some of the bones belonged to members of other races, and they paid no attention to sex, which for the most part was unknown. They counted every scapula measured as one, whether or not its fellow came under observation. They measured also a few scapulæ of other races, but the series were for the most part very small. The largest were twenty-one Andaman scapulæ and twelve Australian.

M. Marius Livon also studied this subject at about the same time, and gave his results in his "Thèse pour le Doctorat," which appeared in 1879. I have never seen his essay, and know it only by references to it by Sir William Turner[1] and by M. Manouvrier.[2] He measured the bones of seventy-three Frenchmen and fifty-one Frenchwomen.

Negroes, Andamanese, and Australians have higher indices, which means broader scapulæ, and consequently of a lower type. Broca points out, however, in his remarks about negroes, that this is true only of the mean, and that individuals of both classes are found to vary very much from it. Indeed, the anthropoid apes may have at least a scapular index within the range of the variations of man. The greater obliquity of the spine in apes makes their infra-spinous angle more characteristic.

Broca claimed that, in spite of the great individual variation, this method is of value when applied to groups.

I began a series of measurements of human and of anthropoid shoulder-blades several years ago and put it aside for other work. I have recently resumed it. My original purpose had been simply to collect additional statistics, but as I went on I was much struck by the diversity of forms which the scapula presents, as well as by the variation of the indices. I became convinced both that

[1] "Challenger" Reports, vol. xvi.

[2] Revue d'Anthropologie, 2me série, tome iii., 1880.

the indices do not necessarily indicate the shape of the bone, and that they are worthless to determine the race of any single bone.

The one hundred and thirteen bones which I have called Caucasian are, like those used by Flower and Garson, rather a heterogeneous collection. They for the most part belong to the Harvard Medical School and to the Boston Society of Natural History. More than a few of them came from France. While they, no doubt, are in the main Caucasian, it is probable that there are some negro bones among them. Indeed, I know that two of the scapulæ came from the body of a negro. These are remarkable as presenting very low (instead of high) indices.

Through the kindness of Professor Putnam, who most generously put all the stores of the Peabody Museum of Archæology at my disposition, I had hoped to be able to present a large collection of figures from the bones of the mound-builders, and perhaps to make observations on many individuals of a race which was less mixed than most of those whose bones are easily obtained to-day. I was, however, disappointed, and from a cause that is easy to foresee, namely, the great fragility of the scapula. I could have had long bones in abundance, but the shoulder-blades were for the most part either in fragments, or so injured that the necessary measurements could not be made. I have the records of six scapulæ from California which are probably Indian, and of eighteen from the Kentucky mounds. The mean of the Californians is 67.25 for the scapular index and 91.05 for the infra-spinous. The mound-builders have a mean scapular index of 69.29 and an infra-spinous one of 93.75.

The following table shows the indices of Caucasian bones obtained by my predecessors and myself. Livon is the only one who has a tolerably large series showing the difference between the sexes. Broca, with a much smaller series, had different results:

TABLE I.

	Broca.	Flower and Garson.	Livon.		Dwight.
			Male.	Female.	
Scapular index	65.91	65.2	63.0	67.4	63.5
Infra-spinous index.....	87.79	89 4	85.4	88.8	85.8

To understand the significance of figures something more is needed than an average, which gives no hint of the range of variation, and accordingly I have arranged the figures of the in-

dices of the Caucasians and mound-builders in groups. The first row of figures shows the index, and opposite each is placed the number of scapulæ having that figure (or that figure and a fraction) for an index. The six Californians showed no extreme figures.[1]

TABLE II.

Scapular Index.			Infra-spinous Index.		
Index.	Caucasians.	Mound-builders.	Index.	Caucasians.	Mound-builders.
55	2	...	72	2	...
56	3	...	73	...	...
57	5	...	74	...	...
58	7	...	75	1	...
59	5	...	76	2	...
60	9	...	77	4	...
61	8	...	78	4	...
62	12	...	79	8	...
63	13	1	80	7	...
64	6	...	81	4	...
65	11	2	82	6	...
66	10	3	83	5	...
67	8	2	84	4	...
68	1	3	85	10	...
69	4	1	86	7	...
70	3	1	87	10	...
71	3	1	88	5	3
72	1	1	89	3	3
73	1	...	90	8	3
74	...	...	91	1	...
75	...	...	92	6	2
76	1	1	93	2	1
77	...	1	94	5	...
78	...	...	95	2	1
79	...	...	96	3	1
80	...	...	97	1	1
81	...	...	98	1	...
82	...	1	99	...	...
			100	1	...
			101	...	...
			102	1	...
			103	...	...
			104	...	...
			105	...	1
			106	...	1
			107	...	1
Total.....	113	18	Total.....	113	18
Mean.....	63.50	69.29	Mean.....	85.83	93.75

[1] There can be no question that in measurements the "personal equation" has its effect. No doubt the discrepancies would have been less if all the measurements had been made by one man. The very greatest care is needed to avoid mistakes. I was much mortified at the conclusion of this work to find inaccuracies in the measurements of two bones, the results of which it was practically impossible to rectify. Happily the errors are of little consequence.

The scapulæ from Kentucky have a decidedly higher index than the Caucasians, and this is evidently not due to individual peculiarities, for though three specimens with remarkably high indices have their effect on the average, yet the scapular index is only once, and the infra-spinous never, as low as the Caucasian mean.

Broca gives some of his extreme figures, which are very interesting. The bone with the lowest indices belonged to a Turk from Smyrna; the next lowest scapular index was furnished by a Frenchwoman, and the next lowest infra-spinous by an Arab. The highest indices belonged to an African negro, by name Tom Blaise, and the next to a black from Hindoostan.

Flower and Garson, unfortunately, make no mention of their extreme cases. For more convenient comparison I put my extremes below Broca's in the following tables:

TABLE III.

MINIMA.

		Scap. Index.	Infra-spin. Index.
Broca.	Turk from Smyrna	57.47	75.19
Broca.	Frenchwoman	60.27	.....
Broca.	Arab	.....	78.57
Dwight.	Caucasian (Fig. 4)	55.1	72.8
Dwight.	Negro (Fig. 10)	58.8	72.3

MAXIMA.

		Scap. Index.	Infra-spin. Index.
Broca.	Tom Blaise	76.64	111.95
Broca.	Black from Hindoostan	76.61	104.39
Dwight.	Kentucky Mound-builder (Fig. 5)	82.2	107.3
Dwight.	Kentucky Mound-builder	77.1	106.9
Dwight.	Highest scapular index among Caucasians	76.3	98.2
Dwight.	Highest infra-spinous index among Caucasians	71.8	102.0

Broca thought it likely (*assez probable*) that his limits would be but rarely passed. Table II. shows, however, that I have measured no less than twenty-two bones with a scapular index below sixty, and that five of them were below fifty-seven. The two given in Table III. are, however, the only ones in which the infra-spinous index falls below seventy-five. Turning to the *maxima*, I have no equal to Tom Blaise in both indices, which is due to the great obliquity of the spine of his scapula, an ape-like feature which the mound-builders cannot rival. One of

them has a scapular index which is decidedly higher, and they both exceed the black from Hindoostan in both respects.

Sir William Turner states in his "Challenger" report that, excluding the scapulæ of one Hottentot, the mean scapular index of several races ranged from 60.3 in the Tasmanians to 70.2 in the Andaman Islanders. This includes the results of some other observers. It would appear, however, that for some reason he has omitted also his four Ohauan (Pacific Islands) scapulæ, which have the extraordinary *means* of 78.8 for the scapular index and 117 for the infra-spinous. He found the variations in the scapular index of African blacks, male and female, to range from 57 to 81, and the infra-spinous index from 30 to 117.

Apart from the range of individual variation in the indices, this method is open to at least two criticisms: first, that there are various forms of scapulæ, which may not be without their ethnological significance, to which these indices give no clue; and, secondly, that the length of the scapula—which is of primary importance in determining the more important index, the scapular—depends in part on the development of the superior angle of the bone. In support of the first criticism I would call attention to two scapulæ (Figs. 6 and 7) whose indices are almost identical, yet which in shape differ enough to be bones of different species. I shall return to these points in the course of the discussion of the variation of different parts of the bone.

Length.—In the one hundred and thirteen Caucasians, all adults, the mean length is 16.22 cm., the extremes being 13.2 and 20.1. There are six under 14 cm. and ten of 18 or more. The mean of the six Californian Indians is 13.62, and of the eighteen from the Kentucky mounds 14.07. The range of variation in these two series is very small. The shortest bone is 12.4, and the longest 15.8, both from Kentucky. These old bones, both in size and shape, constitute a well-marked series.

Professor Mivart, in his well-known paper on the "Appendicular Skeleton of the Primates,"[1] takes several parts of the scapula for comparison. We shall consider the variation that some of these present in man alone.

The inferior angle (Fig. 1),[2] which Professor Mivart puts at

[1] Philosophical Transactions, London, vol. clvii., part 2, 1867.

[2] In Figures 1, 2, and 3 the partial outlines are drawn as though taken from the bone of the right side in every case. This is for convenience.

35° or 40° in man, presents great differences, as is shown by the appended wood-cuts. I give no measurements, as the difficulty of making accurate ones is quite out of proportion to their value. The difference is in part, but not wholly, due to the development of the surface at the lower part of the axillary margin for the teres major.[1] This muscle arises from the dorsal surface of the bone, but there is almost always a slight projection at this point from the anterior border, and occasionally it is developed into a projection of considerable size. Broca states that this is more common in negroes. I have no opinion to offer on this point, but I believe that this process does not stand in direct ratio to the size of the muscle. It is well marked on a very delicate scapula (Fig. 5), and on the other hand there is a large surface to this muscle with hardly any projection on a remarkably sharp bone (Fig. 4). An analogous case is the third trochanter, the occurrence of which, in my opinion, is quite uninfluenced by muscular development. The surface for the *teres major* projects out very strongly in the lower Simiidæ, Cebas, and Chrisothrix, according to Mivart. Its occurrence in man is probably (as in the case of the third trochanter) the appearance of a peculiarity of lower forms. The lower angle, however, varies considerably apart from the influence of this process.

FIG. 1.

The vertebral border (Fig. 2).—The most common form of scapula presents a line slightly curved at the lower part, and then straight as far as the root of the spine, from which point it inclines slightly forward till it ends at the upper angle. The forward inclination of the upper part, though varying in degree, is, so far as I know, constant, but the rest of the line varies much. Sometimes it is almost straight, sometimes the whole border of the bone is convex, sometimes the border below the spine is con-

[1] By another oversight Broca repeatedly calls this muscle "*le petit rond.*"

cave. The different types are seen in the annexed diagram, but, better still, in some of the figures of the entire bone.

The superior border (Fig. 3) is also of uncertain shape. The superior angle cannot be considered apart from the posterior border. The diagrams show its variations so well as to make a description unnecessary. One of these is remarkable as showing the point truncated. None of these, however, show it rounded off in a way that equals the Boschiman scapula figured by Mivart. The variations of this angle are important, because they show that the length of the scapula, as used according to Broca's plan, is liable to vary according to the development of this angle. The

FIG. 2.

FIG. 3.

bone with the truncated angle has of course a scapular index decidedly different from the one it would have if the posterior and superior borders had been prolonged till they met in a sharp point. The differences in depth of the supra-scapular notch, which ranges from the merest deviation of the course of the superior border to a deep notch and then to a foramen, are well known. I have one specimen in which there is a foramen below a deep notch that is almost bridged over. It is the only case of the kind I have ever seen. The only allusion to its occurrence that I know of is in Humphry's "Human Skeleton."

Variations in the concavity of the body of the bone should also be mentioned. If a scapula be laid on a table with the ven-

tral surface downward, it will usually rest on three points,—the coracoid, and the superior and inferior angles. The vertebral border, as a rule, forms an arch, the highest point of which is sometimes about 2 cm. from the table. In other cases this border barely leaves the table, and sometimes one or both of the angles mentioned are bent dorsally, so as no longer to be points of support.

On the dorsum the course of the spine and acromion deserve attention. By comparing the scapular and infra-spinous indices we get some idea of its obliquity. A high infra-spinous index with a moderate scapular index shows, of course, a greater obliquity, which is an ape-like peculiarity. When both are very high it shows simply a short, broad scapula. I called attention to the fact that one of the Kentucky mound-builders had a higher scapular index but a lower infra-spinous one than Broca's negro, Tom Blaise, which means that the former had the relatively broader scapula, but the latter the more oblique spine. A study of the one hundred and thirteen Caucasian shoulder-blades shows that the two indices present no great discrepancies. The average scapular index being 63.50 and the infra-spinous 85.83, I find but three with a scapular index of between 64 and 65 which have an infra-spinous index below 85, and of these the lowest was 82.5. I find none at all with a scapular index above 65 and an infra-spinous below 85. Conversely, only seven having an infra-spinous index above 86 have a scapular index below 63. The lowest of these is 61.

Professor Mivart states that when the bone is so held that the long axis of the glenoid cavity is vertical, and that cavity is opposite the eye of the observer, the acromion is almost always higher than the coracoid in man, troglodytes, and hylobates. I do not remember any exception to this rule in man, but I find a good deal of variation in the direction of the line formed by the projecting edge of the acromion when the bone is thus held. It is not easy to determine what angle it forms with the horizon, and I shall give the mean very vaguely, as probably in the neighborhood of 45°, but I have seen it reach at least 65° on one hand and fall to 30° or less on the other. These two extremes are shown in Figs. 12 and 13. I have been unable to find that either of these degrees of inclination is associated with any particular shape of the bone.

The study of the range of variation in these separate parts leads one to the conclusion that very remarkable scapulæ could be constructed by a judicious selection and union of the most striking individual parts; but it would, I think, be difficult to make more remarkable ones than actually occur. I shall now call attention to some of the most curious specimens. Figs. 4 and 5 show respectively the lowest and the highest indices. The breadth is the same in each, but the length of the latter is little more than two-thirds of that of the former. The process for the teres major, though small, is clearly shown on the scapula of the mound-builder, but the other bone has a larger surface for the origin of the muscle, though there is but a slight projection at the anterior edge, which is confirmatory of the views expressed above. Figs. 6 and 7 have already been alluded to as widely different forms, having almost identical indices. Each is a peculiar bone, but the sharp one is the more uncommon. Figs. 8 and 9 are also in strong contrast to each other. The posterior borders have been figured, but the striking effect is shown in the figures of the whole bones. Each is very peculiar and in a different way, though neither has a remarkable index. Fig. 10 represents a wonderfully long bone,[1] being 20 cm. It is a remarkable specimen, and is among those having the lowest indices. The scapular index is 56.5, and the infra-spinous 76.3. The original of Fig. 11 (scapula index 58.8 and infra-spinous 72.3) is figured because it belonged to a negro and yet had indices far below the mean of Caucasian bones. A comparison of these bones shows assuredly remarkable diversities of form. It is easy to find bones of different species of animals that differ less from one another than do these human ones. I am unable to say what remarkable forms might be seen in a large collection of the shoulder-blades of the Felidæ, but I know that a small collection shows no such range. Even the scapula of the bear differs no more from that of the tiger than some of these from one another. A few notes on the anthropoid apes will be found in the appendix.

What influence the height, the muscular development, the health, and the occupation of the individual may have on the shape of the scapula, and indeed on the skeleton in general,

[1] The mate to this bone is the longest I have measured, exceeding it by more than 1 mm., but it has, unfortunately, been injured.

cannot as yet be much more than guessed at. The question suggests a field for inquiry, which has as yet hardly been opened, but which in the course of years may bear a rich crop. Something has been done in this direction by Mr. W. Arbuthnot Lane, of London.[1]

Livon found that in women both indices were higher than in men, while, as above stated, Broca found the reverse, but in very small series. I do not feel convinced that Livon's are large enough to put the fact beyond question, and certainly it would be rash to draw any conclusion as regards a single individual. Probably the actual size of the bone, and more particularly that of the glenoid cavity, are the best indications of the sex that the bone offers, and these are of but little value.

It must be remembered that the great range of individual variation does not necessarily destroy the value of Broca's indices, but it shows that the method must be applied to large series of bones from well-marked races. It is gratifying to find this view supported by no less an authority than Sir William Turner, who writes, "For I gather from my own measurements and those of other observers, that the range of variation in the relative length and breadth of the scapula is very considerable in the same race, so that it needs a large number of bones to enable one to obtain an accurate idea of the mean of any race."[2]

APPENDIX.

THE INDICES OF ANTHROPOID APES.

Both Broca and Flower and Garson published the indices of anthropoid apes in their papers, which have been referred to so often. As the number of observations is necessarily small, I am glad to be able to offer a few additional ones. Broca gives the indices of ten gorilla skeletons, of five chimpanzees, of one orang, and of seven gibbons. Flower and Garson give the indices of sixteen bones of the gorilla, of twenty-one of the chimpanzee, of seventeen of the orang, and of eight of the gibbon.

[1] The Pathology of Changes produced by Pressure in the Bony Skeleton of the Trunk, Guy's Hospital Reports, vol. xliii., 1886.

[2] It is proper to mention that this paper had been written and sent to the NATURALIST before I had seen Professor Turner's remarks on the scapula in the "Challenger" Reports. Through the courtesy of the editors I have had an opportunity to modify my paper here and there by quoting from his work.

To these I can add the indices of thirteen shoulder-blades of the gorilla, eight of the chimpanzee, and two of the orang.[1]

	Broca.		Flower and Garson.		Dwight.	
	Scap. Ind.	Inf-spin. Ind.	Scap. Ind.	Inf.-spin. Ind.	Scap. Ind.	Inf.-spin. Ind.
Gorilla.....	70.38	126.05	72.2	132.5	70.1	131.7
Chimpanzee...	68.52	130.23	69.9	133.8	68.4	129.1
Orang.....	69.27	97.46	77.6	103.8	73.6	89.7
Gibbon	96.97	198.56	96.5	201.2		

Below are the highest and lowest indices that I found in gorilla and chimpanzee:

		Scapular Index.	Infra-spinous Index.
Gorilla	Highest.....	76.6	153.3
	Lowest.....	66.1	116.0
Chimpanzee...	Highest.....	72.8	136.0
	Lowest.....	66.1	117.5

These figures show that the highest scapular index of the gorilla and chimpanzee is sometimes, though very rarely, surpassed in human bones. I say nothing of the orang, having measured the bones of only one adult skeleton. The case is different, however, with the infra-spinous index, as the lowest of the gorilla and chimpanzee exceeds the highest human one.

Description of Plates.

The views of the dorsum of the scapula are all on the same scale. Figures 12 and 13 are not on precisely the same scale as the others. Figures 6 and 13 are from the same bone. All but 5 and 11 are presumably Caucasian.

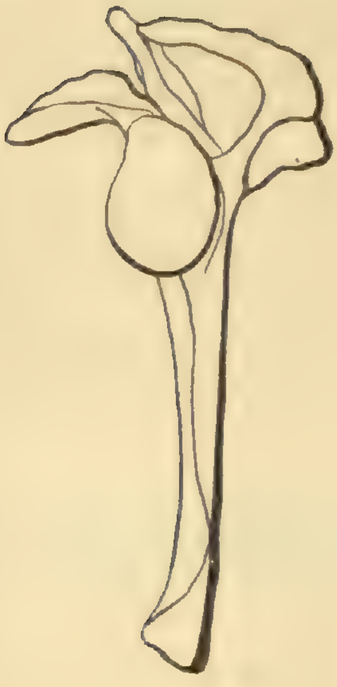
		Scapular Index.	Infra-spinous Index.
Fig. 4.	.....	55.1	72.8
" 5.	From Kentucky mounds.....	82.2	107.3
" 6.	.....	67.8	91.4
" 7.	.....	67.8	90.6
" 8.	Two opposite forms.....	69.4	97.2
" 9.		61.5	91.4
" 10.	A very long bone.....	56.5	76.3
" 11.	Negro.....	58.8	72.3
" 12.	Show extreme degrees of inclination of the acromion.		
" 13.			

[1] In spite of a foot-note on p. 75 of Broca's paper, I confess to some doubt as to whether his figures of ape measurements refer to the number of skeletons or to the number of scapulæ. I have followed Flower and Garson, who reproduce his table, in stating it as I have in the text. My own figures, like theirs, refer to individual bones.

PLATE XXI.

10

11



12

13

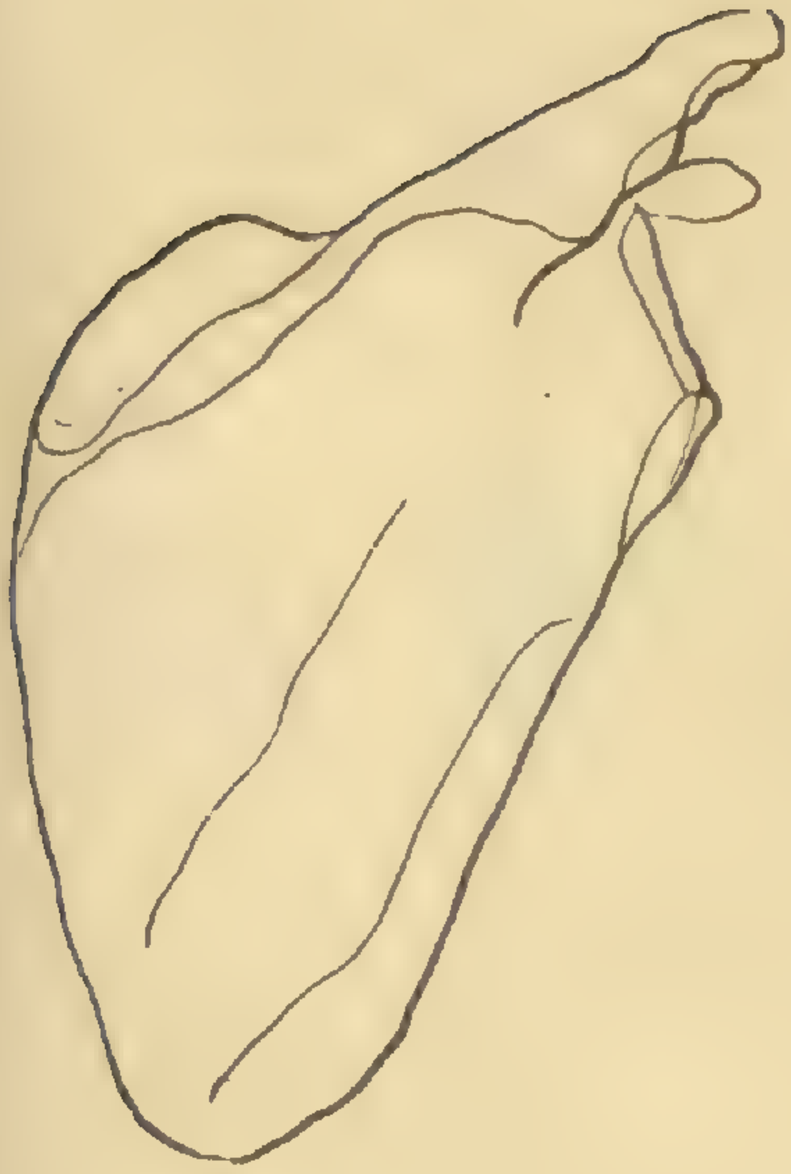
PLATE XX.

4

5

6

7



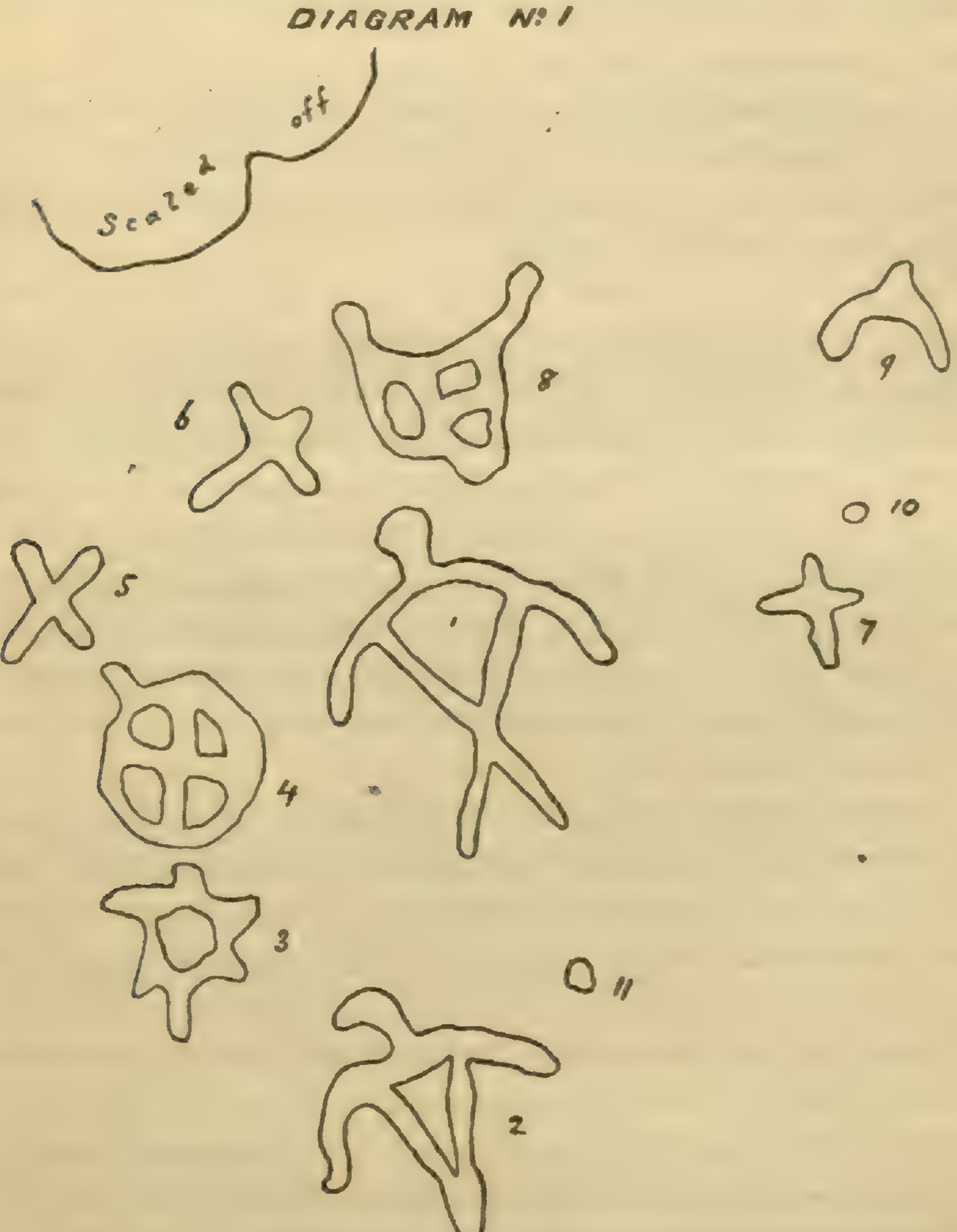
8

9

INCISED BOULDERS IN THE UPPER MINNESOTA VALLEY.

BY T. H. LEWIS.

THERE are other inscribed rocks in the same region besides those of the Thunder Bird's Track described in the AMERICAN NATURALIST for May, 1886, which, like them, should be



preserved from oblivion. The accompanying diagrams and short verbal descriptions will account for three.

This boulder is in the edge of the public park, on the north end of the plateau at Brown's Valley, Minnesota. The plateau is about forty feet above the Minnesota River there. The boulder has a flat surface with a western exposure; is irregular in outline, and is about five feet eight inches in diameter, and firmly imbedded in the terrace.

Fig. 1 is the central figure, and undoubtedly represents a man, although the form is somewhat conventional.

Fig. 2 represents a bird.

Fig. 3 represents a tortoise.

Fig. 4 is a cross and circle combined, but the circle has a groove extending out from it.

Figs. 5, 6, and 7, although somewhat in the shape of crosses, probably represent bird-tracks.

Figs. 8 and 9 are nondescript in character, although there must be some meaning attached to them.

Figs. 10 and 11 are small dots or cups cut into the boulder.

The figures as illustrated are one-eighth of their natural size, and are also correct in their relative positions one to the other. The work is neatly done, although the depth of the incisions is very slight. In 1883, when they were traced, the pictographs were very plain; but during my last visit to this region, in the summer of 1886, the moss was gradually encroaching upon them, and it will be only a matter of a few years before they are entirely covered up.

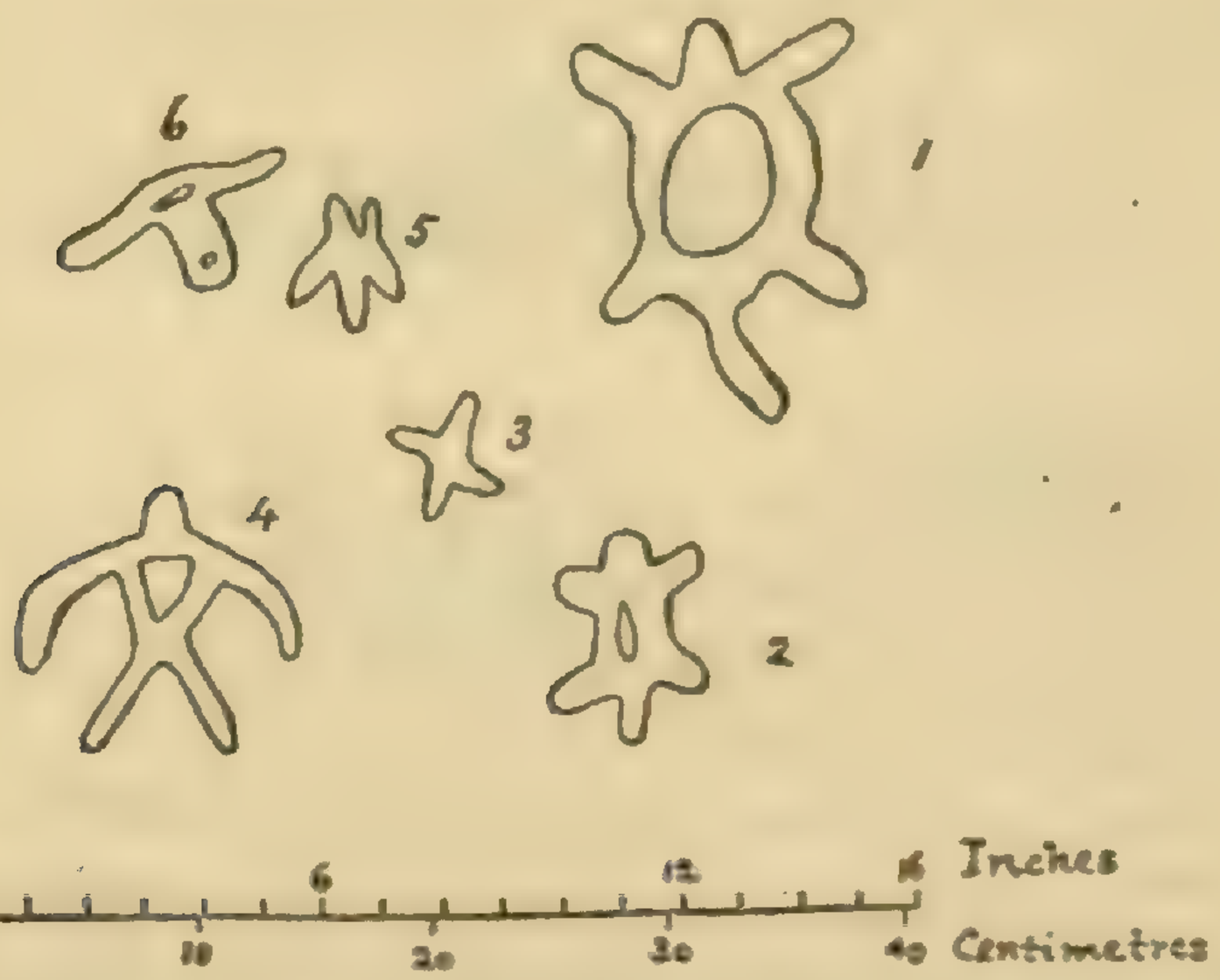
The people of the place call this boulder "the Sacred Rock," and the plateau is also called "Sacred;" but the name has no significance as regards the markings, for two lovers named the boulder without knowing that there were any pictographs upon it.

Strange as it may seem, the Indians of this region have no tradition connected with this boulder, and, in fact, did not know of the existence of the inscriptions until after their discovery by the whites, although the plateau was for many years a general rendezvous for them as a sporting-ground.

As a matter of incidental antiquarian interest here, it may be stated that twelve hundred feet to the eastward of this rock or boulder was situated an ancient enclosure or fort of the mound-builders, of about four acres, with a customary outlying mound near by. One is hardly justified, however, in speculating much

on possible relationship between these two interesting classes of relics of the very old times.

DIAGRAM N° 2



This boulder is on a high terrace on the west side of the Minnesota River, one and a half miles south of Brown's Valley, and is in Roberts County, Dak. It is oblong in form, being three and a half feet in length, two feet in width, and is firmly imbedded in the ground.

Figs. 1 and 2 are undoubtedly tortoises.

Fig. 3 is probably intended to represent a bird-track.

Fig. 4 represents a man, and is similar to the one at Brown's Valley.

Fig. 5 is a nondescript of unusual form.

Fig. 6 is apparently intended to represent a headless bird: in that respect greatly resembling certain earthen effigies in the regions to the southeast.

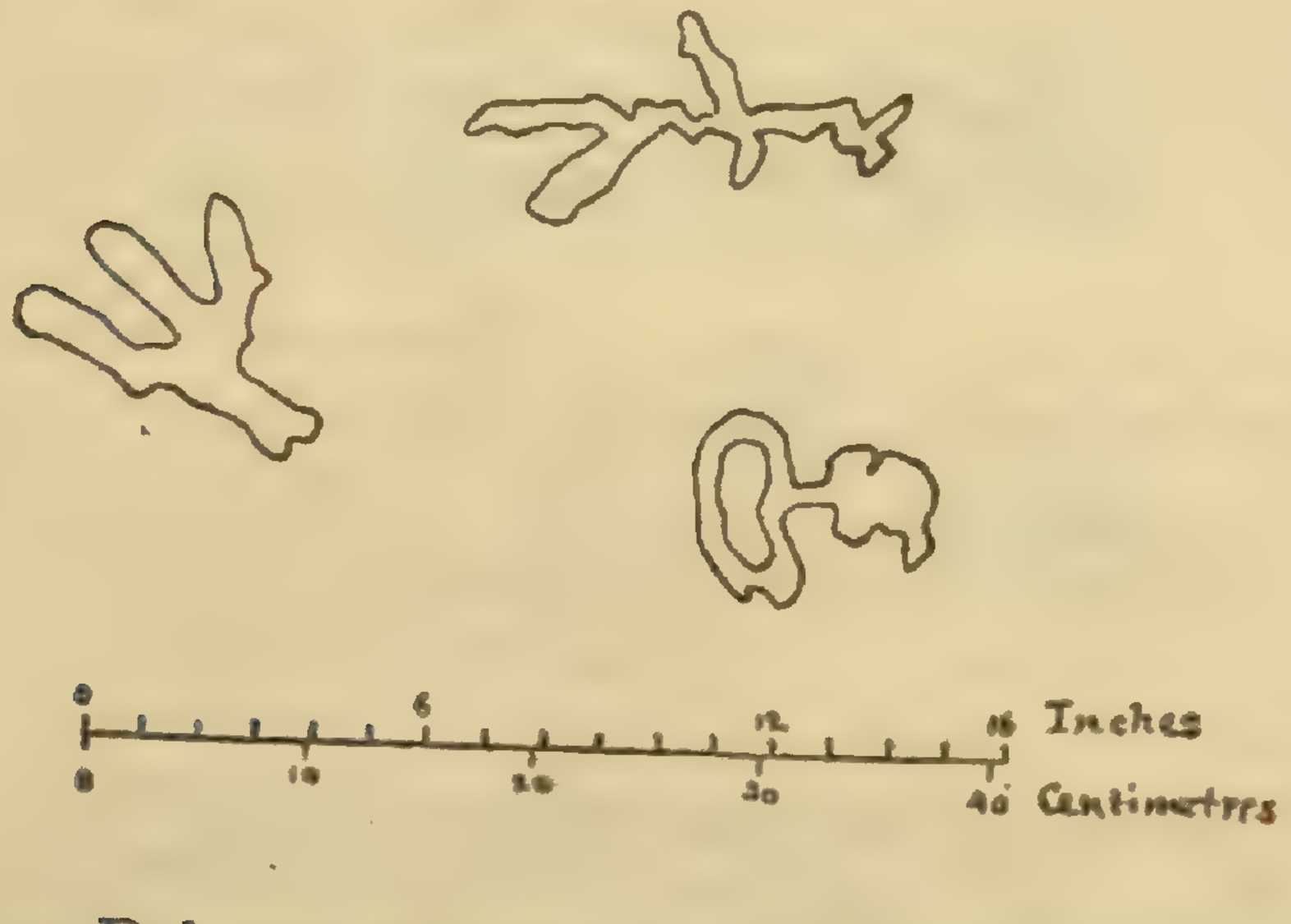
The figures are about one-fourth of an inch in depth, and very smooth, excepting along their edges, which roughness is caused by a slight unevenness of the surface of the boulder.

This boulder is only a short distance from one previously described as "Thunder Bird's Track's Brother," some four miles northwest of Brown's Valley, and, like No. 2, is in Roberts County, Dak.

The figures here represented are roughly pecked into the stone, and were never finished; for the grooves that form the pictographs on other boulders in this region have been rubbed

until they are perfectly smooth. The face of the boulder upon which these occur is about two feet long and one and a half feet in width.

DIAGRAM No. 3



There is a Dakota tradition relating to these incised boulders about as follows:

In olden times there used to be an object that marked the boulders at night. It could be seen, but its exact shape was indistinct. It would work, making sounds like hammering, and occasionally emit a light similar to that of a fire-fly. After finishing its work it would give one hearty laugh, like a woman laughing, and then disappear. The next morning the Indians would find another pictured boulder in the vicinity where the object had been seen the night previous.

The above is only given to show how the Indians account for these incised boulders.

ST. PAUL, MINN., April 6, 1887.

EDITORS' TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

THE principal object of the International Congress of Geologists is the unification of geological methods. This means the adoption of a general system of nomenclature for formations and a system of coloration for maps. The utility of such a project cannot be questioned. Diversity in the practices of different countries on these points is as inconvenient as it is unscientific. It is not a matter of prime importance what names or what colors are used, but it is important that these should be uniform for the world. Two objections have been made to this project. One of these is that there is not identity, properly so called, between the geological formations of the different continents. The other is, that no system adopted under our present knowledge is adapted to express discoveries yet to be made in unexplored regions.

To the first of these so-called objections it may be replied that, since time is one, so geological ages are one for all parts of the earth. Vast tracts of sediments and intrusions have been produced contemporaneously in the past, as they are being now produced in the present. When these formations are identified as contemporaneous they should receive identical names, and be identically colored on geological maps. Of course, the beginnings and ends of the processes of deposition have not been always contemporaneous; so that we have, in variations of this kind, ground for subdivisions of minor extent and importance. But the great "time boundaries"—as they are well termed by Professor Dana—are identical in their central features for the whole earth. The parallelism may be even traced to a lesser grade of divisions, as is well known. It is only in what might be termed the third grade of time divisions based on stratigraphy, that we begin to find identifications impossible. So, of course, the work of the Congress can proceed no further in this direction.

It can, however, digest and codify the results of geological research in all countries to its lowest subdivisions. It can catalogue and compile. Thus an invaluable index to all the formations of all countries may be produced. Such a list, like all

others of the kind, would have to be continually enlarged by new accessions, as in all other departments of science. Thus is answered the second of the objections above referred to.

The above remarks apply both to a system of nomenclature and to a system of coloration. Major J. W. Powell, of the United States Geological Survey, has entered a protest against the adoption of the system of colors generally in use, and has endeavored to secure the adoption of one of his own devising. The following is an extract from a letter which was presented to the last Congress—that of Berlin[1]—by Major Powell:

"It will be observed that in its fundamental principles this system (that in use by the United States Geological Survey) is the antithesis of that in common use (and represented by the European map). With the evolution of geologic science there grew up a system of symbolic, and sometimes denominative, conventions for the representation of geologic phenomena, in which the conventions are designed to suggest the characters and relations of the phenomena. It implies a classification of the phenomena in which each element is properly correlated with each other element, and in which the sum of the recognized elements forms a complete and symmetric whole. In view of the manner in which scientific classification is effected, it involves conference among geologists concerning obscure and doubtful points, in order that a consensus of opinion may be secured; and it requires modification of classification and consequent repetition of conference with each important geologic discovery. Though natural and simple in its inception, the fully developed system is highly artificial and cumbrous. In the system here advocated, the conventions, both symbolic and denominative, are purely arbitrary. No classification save a semi-arbitrary allocation of the grander divisions of the geologic column is necessarily implied in this system, but any classification may be adopted without affecting its integrity; it affords the means of immediately representing new discoveries, and of either tentatively or finally distinguishing phenomena of doubtful significance; and it permits modification of classification, the maintenance of diverse classifications, and the development of classificatory theories at all stages of investigation. Though resting on a partly artificial basis, it is simple and natural in its application.

"The old system is ideographic, connotative, and analytic; the new is alphabetic, denotative, and synthetic; the old system trammels the observer by prescribing rules to which his obser-

[1] The Work of the International Congress of Geologists, and of its Committees, by Dr. P. Frazer, Secretary of the American Committee, 1886, p. 107.

vation must conform, while the new encourages originality by allowing the utmost latitude in expressing the results of observation; the old system tends to retard the development of geologic science, and to restrict its practical application by explicitly postulating its completeness, while the new promotes geology and extends its useful applications by providing the means of expressing discoveries in new as well as in old lines of investigations."

This letter, so far as we understand it, postulates both the objections we have mentioned above, and which we have shown to be groundless.

The Congress of Berlin did not think it advisable to change the system of coloration which had been, in its main features, in use for half a century, and the American Committee has accepted its decision. In this the committee has adopted the views of utility generally entertained in Europe. The committee, at its Albany meeting, however, expressly insisted on the necessity of incorporating into the general system all new and additional details to be derived from the explorations conducted in non-European countries, thus providing for the contingency referred to by Major Powell in the letter above quoted.

A great deal of labor devolves on the Congress and its committees. Their only reward is the belief that their work is a useful one, and the confidence that, if well done, it will endure, so far as it goes, as a permanent standard of estimation for the entire world, and for all time.

RECENT LITERATURE.

Proceedings of the American Society of Microscopists.[1]— The most notable of the papers read at the Chautauqua meeting of this society were the address of the president, Dr. Thomas J. Burrill, on bacteria and disease; Professor Hamilton L. Smith's contribution to the life-history of the Diatomaceæ; the papers of H. A. Weber and Thomas Taylor on butter and its adulterations, and that of Dr. George E. Fell on *Demodex folliculorum* in diseases of the human face. The first of these is an interesting presen-

[1] Proceedings of the American Society of Microscopists, Ninth Annual Meeting, held at Chautauqua, N. Y., August 10, 11, 12, and 13, 1886. Buffalo, N. Y., 1886, pp. 243, pls. 7.

tation of the part played by bacteria in disease, and gives many facts which fully support his conclusions. Dr. Smith's elaborately illustrated paper is better than most of the American diatom literature, as it deals with structure rather than with "resolution." The papers upon the detection of adulterated butter seem conclusive that the microscope alone is not sufficient to decide in all cases, or, at least, until new tests are discovered.

There can be no doubt that this society is doing a good work, and while it is the means of publishing much that is crude, and which might better be left in manuscript, it still serves as a centre for many who otherwise would not belong to any scientific association. To the charge that sufficient censorship is not exercised in the acceptation of papers for publication, the much larger American Association for the Advancement of Science is equally open. Indeed, such criticism applies with much more force to the latter than to the former association, for with a total of about three hundred and seventy-five members the Microscopical Society have a very substantial financial balance on hand, while the larger American Association, with a membership of eighteen hundred and eighty-six, are several thousand dollars in debt.

The Fourth Report of the Bureau of Ethnology.[1]—The present volume keeps up the high standard of the series and deserves more space than our limits will allow. The report proper of the director details the operations of the bureau in the fiscal year 1882–83, while the accompanying papers, five in number, have far more general interest. Two more papers were prepared for the present volume,—one by Professor Cyrus Thomas on the burial mounds of the Northern United States, the other by Charles C. Royce on the relations of the Cherokees to the colonial governments,—but were postponed to the next volume from lack of room. The first of the papers now before us is confessedly a preliminary study by Colonel Garrick Mallery of the picture-writing of the North American Indians. In it no conclusions are drawn, but the paper, which is fully illustrated, aims to present the material already collected as a guide for future collections. Notwithstanding this fact the paper is of great interest, and possibly gains from the fact that each reader is able to form his own conclusions unwarped by any theory of the writer. The impression the article creates in the present reviewer is that the simplest explanation of any pictograph is most likely to be the right one, and any forced or symbolical interpretation is apt to violate the nature of at least the Indians of North America. The other articles of the volume relate to pottery. Three by Mr. William H. Holmes deal respectively with

[1] Fourth Annual Report of the Bureau of Ethnology to the Secretary of the Smithsonian Institution, 1882–83, by J. W. Powell, Director. 4to, pp. 63 + 532, pls. 83. Washington, 1886 (1887).

the "Pottery of the Ancient Pueblos," the "Ancient Pottery of the Mississippi Valley," and as a corollary thereto the "Origin and Development of Ornament in Ceramic Art." Mr. F. H. Cushing gives a study of Pueblo pottery as illustrative of Zuñi culture-growth. These papers afford ample illustrations of the laws already laid down of the development of the ceramic art, and are to be regarded as proving and confirming the gradual evolution of the potter's trade, rather than as advancing new ideas. This, however, must not be taken as adverse criticism, but, on the contrary, as a recognition of an important point in the articles. In connection with them the reader should refer to Professor F. W. Putnam's recent paper on "Conventionalism in Ancient American Art" (*Bulletin Essex Inst.*, xviii., 1887), to which we shall have occasion to refer again.

Beal's Grasses of North America.[1]—This volume is, in fact, Part I. of a large work the second part of which, we are informed in the preface, is in preparation. When completed it will be the most important work on grasses ever brought out in this country. The part before us includes seventeen chapters devoted to the following subjects,—viz., structure, form, and development of grasses; the power of motion in plants; plant-growth; classifying, naming, describing, collecting, studying; native grazing-lands; grasses for cultivation; early attempts to cultivate grasses; testing seeds; some common weeds; grasses for pastures and meadows; preparation of the soil, and seeding; care of grass-lands; making hay; look the world over for better grasses, and improve those we now have; grasses for the lawn, the garden, and for decoration; the Leguminosæ, pulse family; the enemies of grasses and clovers; the fungi of forage-plants.

It will thus be seen that the range of topics is much wider than that which we usually find in books designed for popular use. In fact, it is doubtful whether many farmers will care much for the first three or four chapters; but, for all that, it is a hopeful sign when an author who is as well acquainted with the farming classes as Dr. Beal is, will deliberately open his book with a scientific discussion of structure, form, and development. Many a farm boy, in consulting this book, will be inspired with a desire to learn more about the methods of scientific study.

In the first chapter there are many matters touched upon which are interesting to the scientific botanist. The closed sheaths of some grasses and the partially-closed ones of many others are referred to, and some interesting figures are given. The mech-

[1] Grasses of North America, fór Farmers and Students, comprising chapters on their physiology, composition, selection, improving, cultivation, management of grass lands; also chapters on clovers, injurious insects, and fungi. By W. J. Beal, M.A., M.Sc., Ph.D., Professor of Botany and Forestry in Michigan Agricultural College. Published and copyrighted by the author. Agricultural College, Mich., 1887. Pp. xiv. 457, with 175 figures. Price, $2.50.

anism for opening and closing the leaf-blades is discussed at some length, and amply illustrated. Many a botanist will here find a fuller account of the curious "bulliform cells" of the grass-leaves than he can readily find access to elsewhere. The torsion of the leaves is another curious subject to which some attention is given. "In half or more of the grasses examined, the whole or a majority of the leaves, by a twist of the lower portion of the blade, turn 'wrong side up' and expose the lower side to the sunlight."

The style of the author is well adapted to the purpose of the book, and no farmer need hesitate to purchase it for fear of its being too technical. The mechanical execution of the book is good, the illustrations are accurate, and the printing is well done upon good paper. Some typographical errors mar the pages here and there; but these can easily be corrected in a second edition, which will certainly be demanded. The author is to be congratulated upon the successful completion of this valuable book. The second part will be looked for with keen interest.—*Charles E. Bessey.*

RECENT BOOKS AND PAMPHLETS.

Smithsonian Institution.—Annual Report of the Board of Regents for 1884. Part II. Report on the U. S. National Museum, by G. B. Goode; with papers on the collections, by O. T. Mason, J. Murdoch, F. W. True, etc.

White, F. E., Dr.—Hygiene as a Basis of Morals. Reprinted from Popular Science Monthly, 1887. From the author.

Stone, G. H.—Terminal Moraines in Maine. From the author. 1887.

Giard, M. A.—Sur la castration parasitaire chez *l'Eupagurus bernhardus* Linné et chez la *Gebia stellata* Montagu. 1887.—Sur un Copepode parasite de *l'Amphiura squamata*. 1887. Both from the author.

Boulenger, G. A.—On New Batrachians from Malacca.—Remarks on Dr. A. Strauch's Catalogue of the Geckos in the Zoological Museum of St. Petersburg.—Description of a New Tailed Batrachian from Corea.—On New Fishes from the Lower Congo.—On a New Calamaria from Borneo.—A Synopsis of the Snakes of South Africa.—Description of a New Megalophrys. All from Ann. and Mag. Nat. History, 1887.

Halsted, B. D.—Bulletin of the Iowa Agricultural College, 1886. From the author.

Stevenson, J. J.—A Geological Reconnoissance of Bland, Giles, Wythe, and portions of Pulaski and Montgomery Counties, Va. 1887. From the author.

Lighthall, W. D.—Sketch of a New Utilitarianism. Montreal, 1887. From the author.

Cook, G. H.—Annual Report of the State Geologist (N. J.) for 1886. From the author.

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Woodward, A. S.—Notes on some Post-Liassic Species of Acrodus. Geol. Mag., 1887. From the author.

McCalley, H.—On the Warrior Coalfield. Geol. Surv. of Ala. From the author.

Minot, C. S.—Researches on Growth and Death. 1884.—Biological Problems. Both from the author.

Dawson, G. M.—The Canadian Rocky Mountains. Reprinted from Canadian Record of Science, 1886. From the author.

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Tuckerman, F.—Supernumerary Leg in a Male Frog. From the author.

Eigenmann, C. H., *Horning, J. E., Miss.*} Review of the Chætodontidæ of North America. Ext. Ann. N. Y. Acad. Sci., January, 1887. From the authors.

Warring, C. B.—Certain Laws of Gyrating Bodies. 1887. From the author.

Torre, v. Dalla.—Bio-psychologisches aus der Vogelwelt.

Rice, W. N.—On Trap and Sandstone in the Gorge of Farmington River, Tariffville, Conn. Am. Jour. Sci., December, 1886. From the author.

Vetter, B.—Die Paläontologie vor dem Kongress der Vereinigten Staaten. From the author.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.

General.—It is pointed out by Ed. Heawood, in a recent number of the *Proc. Roy. Geog. Soc.*, that the relations of length of the eight principal rivers given by General Tillo would be greatly altered were the general course taken, and the minor tortuosities left out. The Nile would unquestionably then be the longest river (3100 miles), the Yang-tse-Kiang (2750) and Yenesei (2700) would exceed the Amazons (2600), and this the Mississippi (2500), while the Congo would equal the Mississippi, and the Amur (2200) and Mackenzie (1800) would come after the Hoang-Ho, Obi-Irtish, Lena, and Mekong.

America. Mounts Hood, St. Elias, and Wrangel.—Heights of mountains and lengths of rivers seem to be rather good exercises for memory than ascertained facts, yet we must presume that triangulation is gradually bringing the mountains at least into their proper place. Mount Hood, in Oregon, has undergone great reduction by this means. Once "roughly" estimated at 17,000 feet, and "closely" at 16,000, a triangulation brought it down to 13,000; an aneroid barometer is said to have made it 12,000, and a mercurial barometer reduced it to 11,225. Mount St. Elias has by similar processes been elevated from D'Agelet's

estimate of 12,672 feet to 19,500, according to the triangulation of Mr. Baker. This may yet undergo some change, but from the account of Mr. Seton Karr it appears that the breadth of its form and the high mountains behind it caused Mount St. Elias to be underestimated, while the isolated position of Mount Hood caused the reverse. It is now stated that Mount Wrangel, some distance to the north of Mount St. Elias, rises 18,400 feet above the forks of Copper River, which are 2000 feet above the sea. If this estimate, made by Lieutenant Allen, is correct, Mount Wrangel is 1000 feet higher than Mount St. Elias, so that after all the United States possesses the highest peak on the North American continent.

ALASKA GLACIERS.—The country that intervenes between the St. Elias Alps and the sea, from Cross Sound to the Copper River (Alaska), with the exception of small areas of flat land east of Yakatat Bay, and east of Icy Bay, consists entirely of glaciers, the terminal moraines of which are so extensive that the ice lies buried under millions of tons and hundreds of square miles of loose rocks which it has carried down from the mountains. The Agassiz Glacier is probably about six hundred square miles in extent, while the Great Guyot Glacier, west of it, is of quite unknown area. The early navigators mistook the nature of the country. Vancouver describes it as "a barren country, composed of loose stones," and La Perouse mistook the protruding ice for snow lying on the ground.

Africa. THE MAKUA.—The article by J. T. Wills, entitled "Between the Nile and the Congo," in the May issue of the *Proceedings of the Royal Geographical Society*, is sad reading. It gives the history of the explorations carried on, and also of the wars and intrigues that have followed one another in the fertile water-shed of the Nile. Clearly the chief result of European exploration and feeble Egyptian interference has been to let the slave-trading Arabs into regions before unvisited by them, and the "brave men struggling to be free" of the Soudan prove, when looked at in the light of the lives of such men as Gordon, Lupton, Gessi, and others, whose lives or liberties have been sacrificed in the attempt to maintain order, to be bloodthirsty slave-hunters. The argument of the article, based upon the comparative volumes and directions of the respective rivers, is that the Makua, or Welle, is identical with the Mobangi tributary of the Congo, and cannot possibly be the Ardhe branch of the Shari. It at any rate appears certain that the Ngala, or Mungala, is not the Makua, since the former was found by Lieutenant Baert to have a breadth of only eleven yards and a depth of five feet, while the Welle at Ali Kobos in Bassange Land (in a straight line with the Ngala) was so wide that Dr. Junker could not determine it.

Asia. THE SARASWATI.—The importance ascribed in the Vedas to the river Saraswati, there called the "chief and purest of rivers," points, as stated by Mr. R. D. S. Oldham (*Proc. Asiatic Soc. of Bengal*), to some change in the hydrography of the region, since the stream now called the Saraswati is quite insignificant. Mr. Oldham is of opinion that the Jumna, within the recent period of geology, flowed towards the Punjab, and that it gradually abandoned this course for the present one, so that at the age of the Vedas part of the waters flowed to the Punjab and part to the Ganges, under the name of the Jumna. This change of course is similar to that known to have taken place in the Brahmaputra, which during the present century abandoned its old bed and joined the Ganges. Though the old bed receives no water from the main stream except when in flood, the Hindus still call it the Brahmaputra, while the new bed is named Jumna. A dry river-bed, known as the Hakra, Sankra, or Sotar, can be traced for many miles across the Indian Desert, and Mr. Oldham gives reasons for identifying it with the Sutlej.

PREJEVALSKY'S EXPLORATIONS.—Prejevalsky's journeys in Central Asia have probably done more towards the elucidation of the orography, hydrography, and ethnography of the region than those of any other traveller. His first journey (1871–73) was across the Gobi Desert, between Kiachta and Kalgan, and thence westward to Kansu in Western China. He visited Lake Koko Nor, ten thousand eight hundred feet above the sea, entered the saline marshy tract of the Tsaidam, and owing to want of resources was forced to return when about five hundred miles from L'hasa, crossing the Gobi at its widest part. In 1876 he advanced from Kuldja on the Ili (then Russian, but now Chinese), crossed the Thian-Shan into Chinese Turkestan, struck the Tarim, and followed that river to Lake Lob. He was the first European who in modern times has succeeded in reaching this lake. In this journey he discovered the Altyn-tagh, which rises as a precipitous northern boundary to the plateau of Tibet. In 1879, Prejevalsky went southward from Fort Zaisan, in Semipalatinsk, by Lake Uliunghar, and along its feeder, the Urungu, across the Desert of Dzungaria, to that of Gobi. The Dzungarian Desert is bounded on three sides by mountains, while on the east, where the Altai and Thian-Shan approach, an isthmus of sand unites it with the Gobi. It once formed a gulf of the great inland sea, the Kan-hai of the Chinese, which covered the Gobi in distant ages. The most characteristic plant of this and other Central Asian plains or deserts is the saxaul (*Haloxylon ammodendron*) or *zak* of the Mongols, a shrub about four feet high, and six to nine inches thick near the root. It is so brittle as to be useless for building, but yields excellent fuel. The wild horse is only met with in a corner of the desert of Dzungaria, the wild camel both there and near Lake Lob. Passing through the strategic-

ally-important Chinese town of Hami, our traveller crossed the desert at its narrowest place to An-si-chau, and then rested awhile at the fine oasis of Shachau, at the foot of the Nan-shan range. Crossing the Nan-shan, he made his way, in spite of much quiet opposition from the Chinese, to the Mur-ussu, the head-waters of the Yang-tse-Kiang. An uninterrupted gigantic mountain wall stretches from the Hoang-Ho to the Pamir, dividing the great plateau of Central Asia into two parts,—the Mongolian Desert on the north and Tibet on the south. Tsaidam, or Zaidam, may be considered a part of the Tibetan plateau, but is enclosed all around by mountains; southward by the Kuen-luin, which under various names extends from the sources of the Yarkand River far into China proper, and to the north by the Altyn-tagh and Nan-shan. The wild yak, which appears to be found in herds as numerous as once those of the bison in North America, never utters a sound, while the domestic one grunts like a pig.

The pass over the Tang-la range is sixteen thousand seven hundred feet high, but only two thousand one hundred feet above the Mur-ussu, and two thousand above that of the Sang-chu, which is believed to join the Salwin. The chain of lakes, Chargutcho, Amdo-tsonak, etc., and all the streams north of Lhasa, between the Tang-la and Northern Himalaya ranges, including the Sang-chu, flow into the Nap-chu or Kara-assu, which, if not the Salwin, must be the Irawadi. Thus the upper courses of this river and of the Brahmaputra flow for an immense distance from west to east, separated by the Northern Himalayas. Entrance into L'hasa was positively refused, and Prejevalsky returned when within one hundred and seventy miles of it.

On his fourth journey (1883–85) he left Kiachta, and thence from Urga crossed the Gobi to Ala-shan. Leaving a depot at the foot of the Burhan-Buddha, one of the ranges of the Kuen-Lun, he started to explore the sources of the Hoang-Ho, known as the Odontala, or thousand springs. Crossing to the Bhu River, the Di-chu of the Tangutans, the upper course of the Yang-tse, he found it too deep and wide to cross, and proceeded thence to the valley between the Chemen-tagh and the Kuen-Lun. The descent from this gradually-rising valley to Cherchen in the Tarim Desert is so easy that it was probably in ancient times the caravan route between Khoten and China. The Kuen-Lun was found to culminate in the snowy group of Jing-ri (90° E. lat.). He then crossed an unexplored plateau to Lob Nor and visited the oases of Cherchen, Kiria, Nia, and Khoten.

Mr. Carey's Journey.—Mr. Carey, of the Bombay Civil Service, has during the last two years been engaged in exploring Central Asia. His associate is Mr. Andrew Dalglaish, and the rest of the party is made up of pony-drivers and servants. Without any armed escort, but provided with a passport from

Peking, he has made his way quietly among people with whom the Russian explorer came into collision. Passing through Ladak, Mr. Carey proceeded to Northern Tibet, and thence to the plains of Turkestan, near Kiria. From Kuchar the Tarim was followed to Lake Lob. From thence the intention was to go over the Altyn-tagh, but nothing has since been heard from him.

MANCHURIA.—Since their journey to the Peishan Mountain and the sources of the Sangari, Messrs. James, Younghusband, and Fulford have visited some other parts of Manchuria. Colonists were perpetually arriving in Northern Manchuria, but brigandage is rife, and for the most part goes on unpunished, as the Manchu semi-military administration is most effete. The country is very fertile, and only needs good government and security to life and property.

GEOLOGY AND PALÆONTOLOGY.

Notes on the Geology and Lithology of Lake Superior.—At the meeting of the Denison Scientific Association, Granville, Ohio, held April 23, a paper was presented by Messrs. Jones and Tight embodying the results of an excursion to Michipicoten Bay, undertaken by members of the class of lithology, conducted by the professor of geology in Denison University. In a more complete form this paper appears in the laboratory bulletin of the same college, volume ii., art. v., from which the following abstract and the accompanying plates are taken.

The field chosen contains good exposures of three of the great classes of Lake Superior rocks now under discussion. Especially good contacts between the schists regarded as Huronian and the granites variously classed as Laurentian or local-eruptive are afforded at many places along shore. Commenting on McFarlane's description of these contacts, Wadsworth says ("Azoic System," p. 346), "His observations show clearly that both formations here are eruptive and of the same geological age." The present paper shows that McFarlane overlooked the sharply-defined contact between the great dyke of "dense basaltic greenstone, having the peculiar dolerytic glitter" (a typical coarse diabase), and the series of (here hornblendic) schists which are at places greatly contorted by the influence of the granite and the diabases. The schists can everywhere be easily distinguished from the penetrating dykes, which lie in strike or dip. They are prevailingly chloritic, containing large quantities of calcite. At more or less regular intervals are beds of schist-conglomerate, which are regarded by the writers as true basement conglomerates. The pebbles are sometimes very large, and consist of granite and felsite-porphyry, often retaining the primitive jointing planes. The schists are here and there perforated by belts of felsite-porphyry, the feldspar being chiefly oligoclase. An

interesting instance of the formation of a porphyry from the fusion of the schist-conglomerate by contact action of a diabase-aphanite or porphyrite is noted. In what may be assumed to be the centre of the fold are great beds of calcareous gneiss, often with sillimanite (?) needles. These are the only stratified granitic rocks seen, and form an integral part of the schist series. Dykes of diorite are very frequent in the schist, and in every case assimilate the adjacent schist to them very closely in general appearance, though the microscopic character may be quite markedly different. The method of occurrence suggests that the diorites are really but fused portions of the schists pressed up through the pasty yielding schist, which thus is greatly affected by the contact. The diabases, on the other hand, are of a much later origin, and perforate the granite as well as the schist. The felsite-porphyries are thought possibly to have been formed from the injection of matter from the granite below at the same time at which the diorites were formed and before some subsequent metamorphism, which involves the schist and all its intrusives except the diabases. A curious modification of some of the diorites is described, by which the long twins of actinolite have lost their pleochroism completely, although still preserving the normal angle of the optical to the crystallographic axis. The hornblende becomes exceedingly like augite in appearance and polarization. Much that has been called diorite-slate and diabase-schist, when carefully studied, can be analyzed into various intrusive diorites, closely assimilated to intervening beds of mica, and hornblendic-schist or a cherty quartz-schist so altered as to be scarcely identified. The Keweenaw series, which laps upon the eastern shore of Michipicoten Bay, is thought to occupy an original synclinal, though great erosion must have preceded the formation of the conglomerates which are the lowest members visible. On the island of Michipicoten these conglomerates are well exposed, and a careful study of their pebbles shows that they can all be referred to some one or other of the formations now visible along the north shore of the lake. The same granites, felsites, schists, and diorites can be identified. Chemical analysis does not detect copper in any part of the conglomerate studied, but everything seems to point to its origin from the amygdaloids, which everywhere cap the conglomerate and have in some places greatly metamorphosed the latter. Indeed, the writers of the paper incline to believe that some or all of the peculiar ferrugineous quartz-porphyry, forming the only acid eruptive seen upon the island, may be the result of such metamorphism of the conglomerate. Space does not permit a more extended reference to the interesting intrusives of the Keweenaw series, which deserve a careful and critical study. Microscopic sections of the rocks described are offered for exchange.—*H.*

DESCRIPTION OF PLATES.

PLATE XXII.

FIGS. 1–3. Modified chloritic schist at contact with a diorite to which it is assimilated. Figs. 1 and 3 are parallel to the lamination, Fig. 2 transverse. Fig. 1 shows decomposed crystals of orthoclase in a chloritic magma, with apatite and titanic iron. In Fig. 3 a large corroded crystal of calcite is shown as appearing between crossed nicols.

FIG. 4. A section of the large dyke of coarse diabase northeast from Michipicoten Island, at the western limit of the bay. The section shows only augite and labradorite in ordinary light.

FIG. 5. Pseudomorphs of chlorite after mica.

FIG. 6. A baveno twin of orthoclase from a granite.

FIG. 7. Diabase-aphanite toping the conglomerate on Michipicoten Island. A fine crystal of plagioclase is figured in a cryptocrystalline base.

FIG. 8. Twin of augite passing to uralite, from dyke of diabase at Dog River.

FIG. 9. View of the schist conglomerate at Dog River. Greatly reduced from a photograph.

FIG. 10. Hypothetical north and south section of the Lake Superior basin, partly after Irving.

PLATE XXIII.

FIG. 1. Section of quartz-porphyry from Michipicoten Island.

FIG. 2. Altered mica-schist from a boulder in the conglomerate.

FIGS. 3 and 4. Pseudamygdules from the diabases.

FIG. 5. Twin of augite from a granite on the north shore.

FIG. 6. Highly magnified portion of section of diabase-aphanite or porphyrite at Dog River, showing titanic iron in dendritic forms.

FIG. 7. Section of an altered diabase-porphyrite from Michipicoten Island, with concentric pseudamygdules of chlorite in stellate, polyhedral aggregates.

FIG. 8. Decaying crystal of plagioclase.

FIG. 9. Sketch map of region studied. Strike of the Keweenaw indicated by dotted lines.

Pavlow on the Ancestry of Ungulates.[1]—In this brochure the authoress recites the work done in Europe and North America towards the elucidation of the history of the origin and succession of the primitive Ungulata. Besides the literature of the subject, the University of Moscow possesses a series of casts of moulds made by Professor W. Kowalevsky from specimens of the Mammalia of the Puerco epoch in the collection of Professor Cope. The objects of the paper are stated as follows:

"1. I will present the successive modifications of the ideas of Professor Cope on the position of the group Condylarthra in the system.

"2. I will give a synopsis of the description of this group, such as has been given by Cope.

"3. I will analyze the opinions expressed by Messrs. Wortman and Schlosser as to this group.

"4. I will study the principles developed by the investigation of this group, in order to show that its different members are probably predecessors (ancestors ?) of certain orders of mammals; and,

"5. I will finally inquire whether the European fauna does

[1] Etudes sur l'Histoire Paléontologique des Ongulés en Amérique et en Europe. I. Groupe Primitive de l'Eocène inférieur. Par Marie Pavlow, Moscou, 1887.

PLATE XXII.

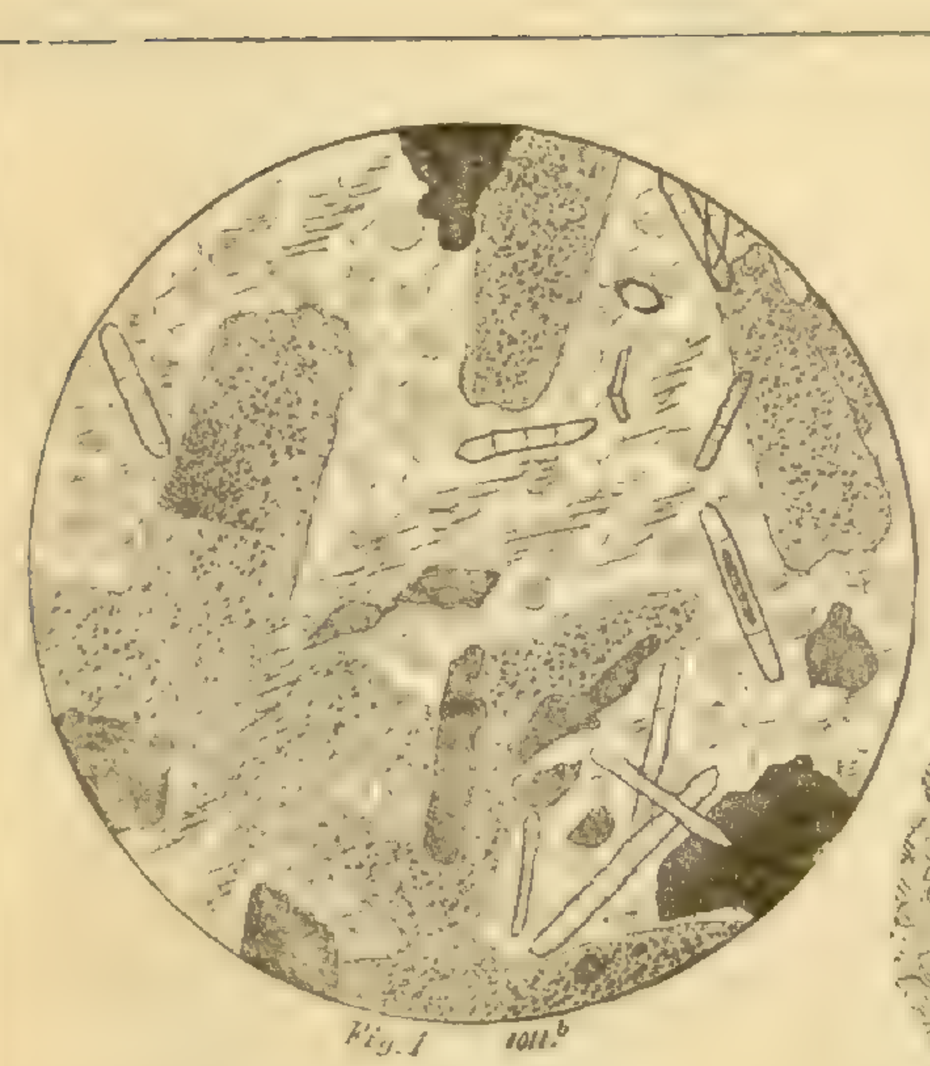
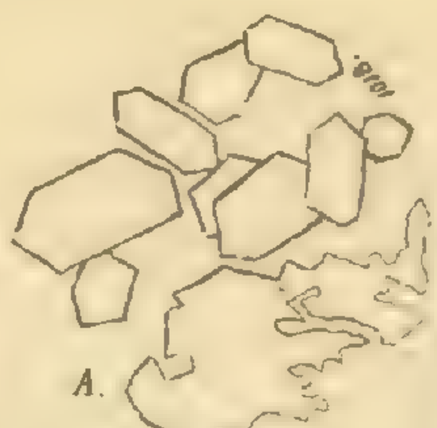


Fig. 1



A.

B.

Fig. 5.

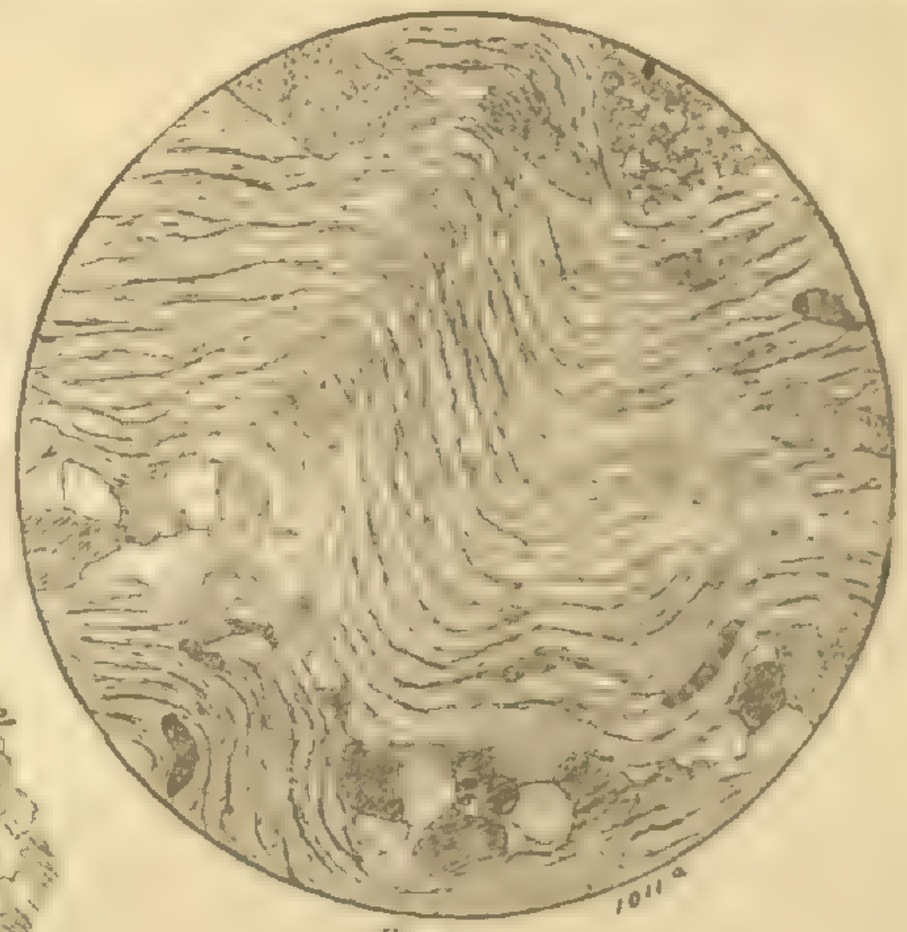


Fig. 2

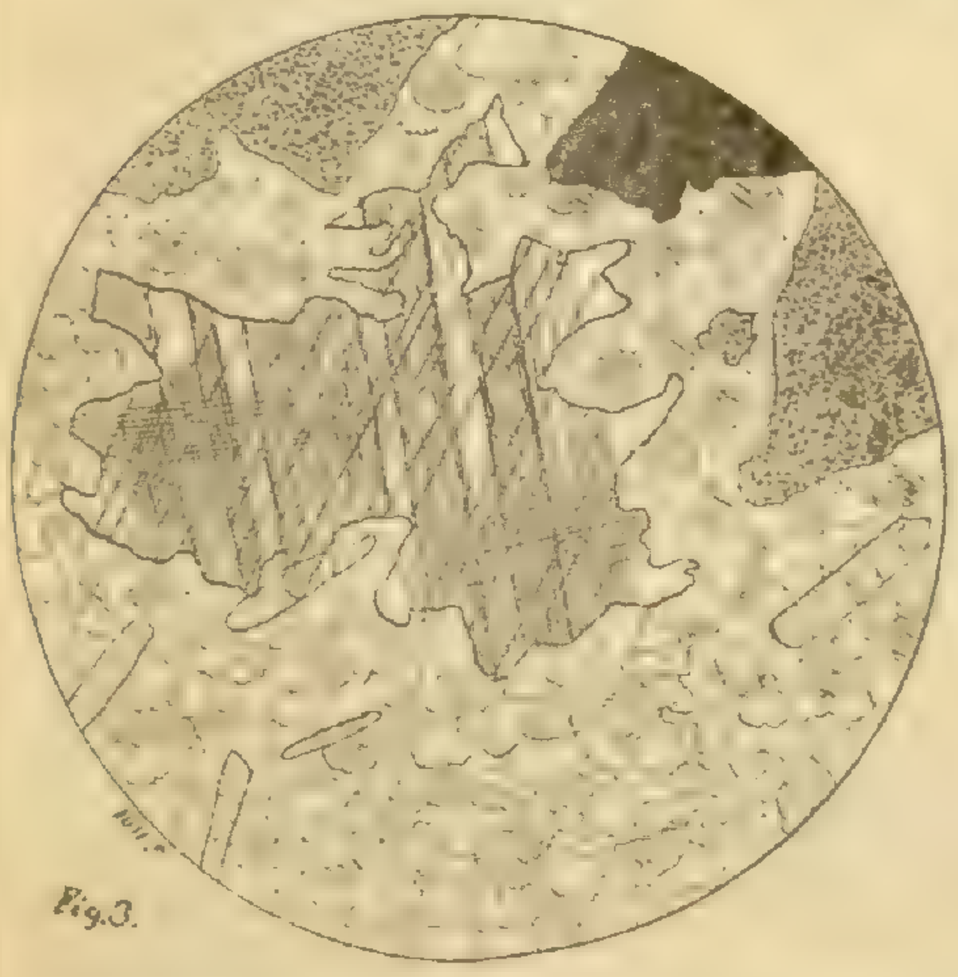


Fig. 3.

Fig. 6.

Fig. 4

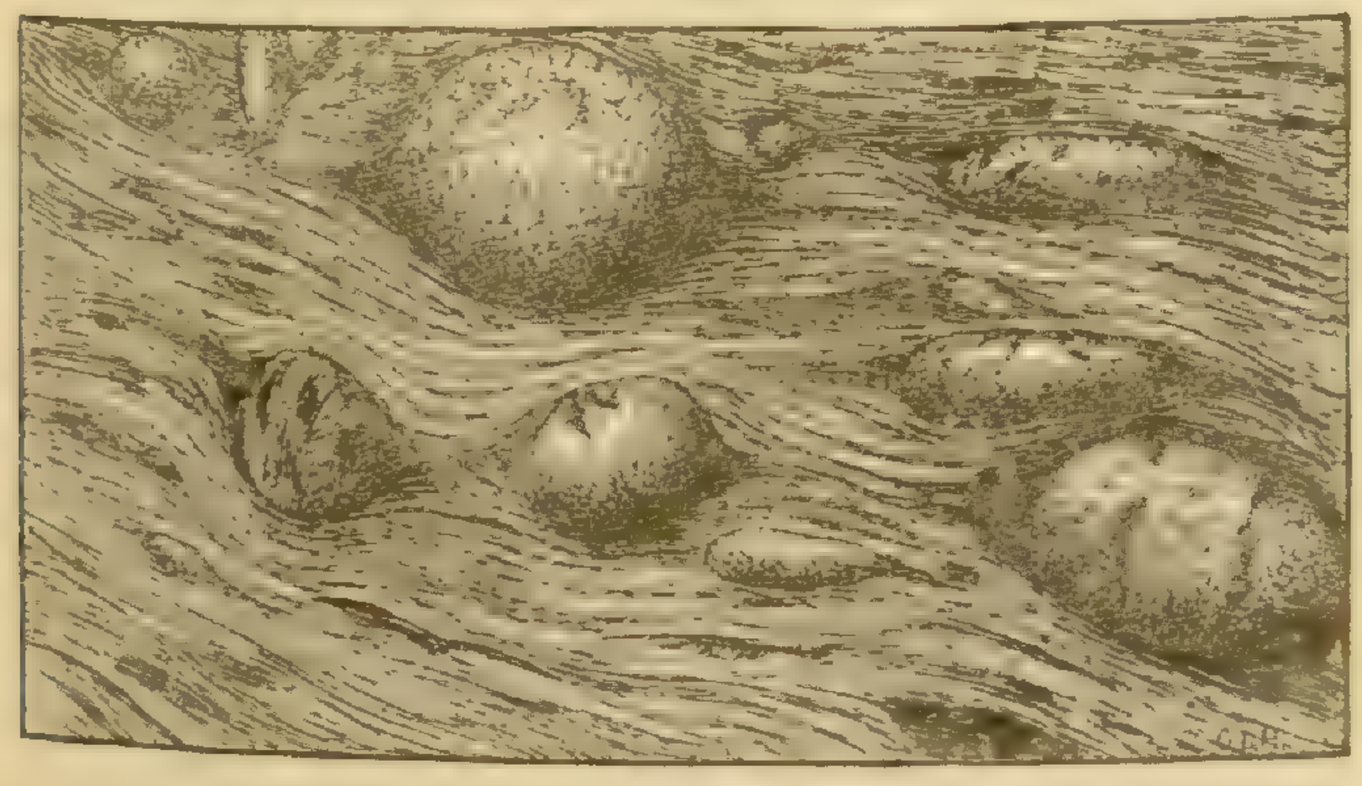


Fig. 9.

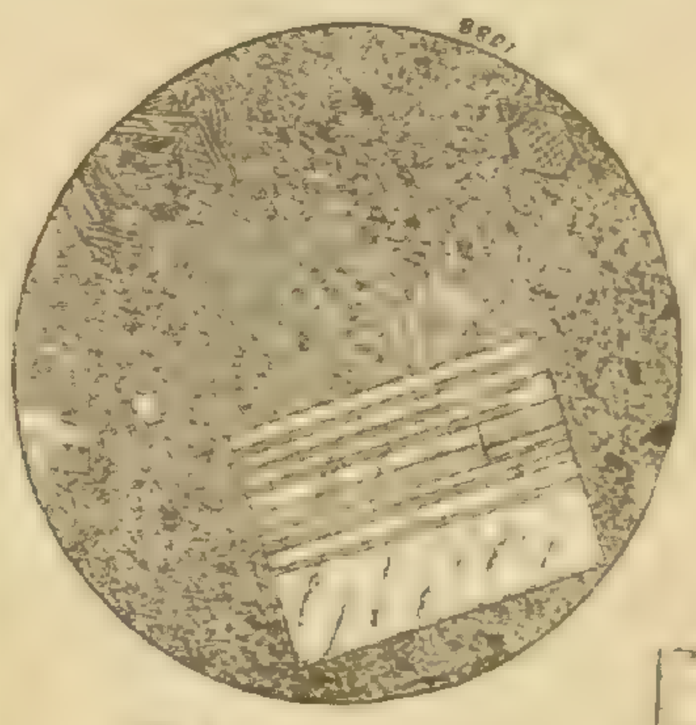


Fig. 7.

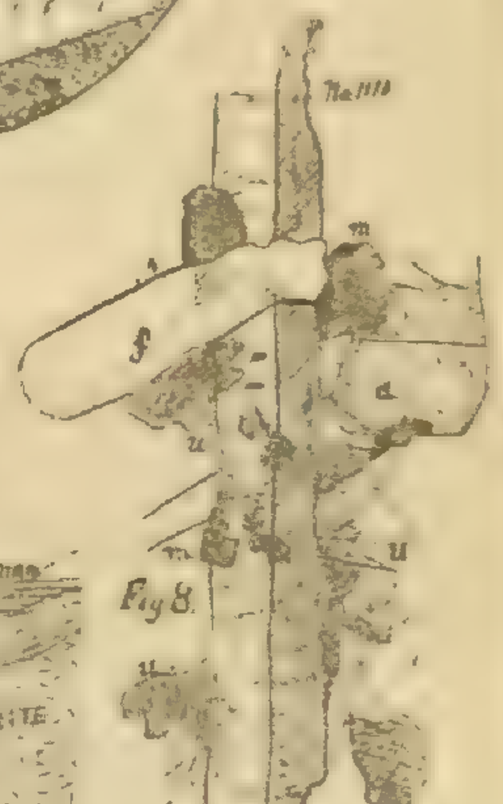


Fig 8.

Fig. 10.

Tight & Herrick.

PLATE XXIII.

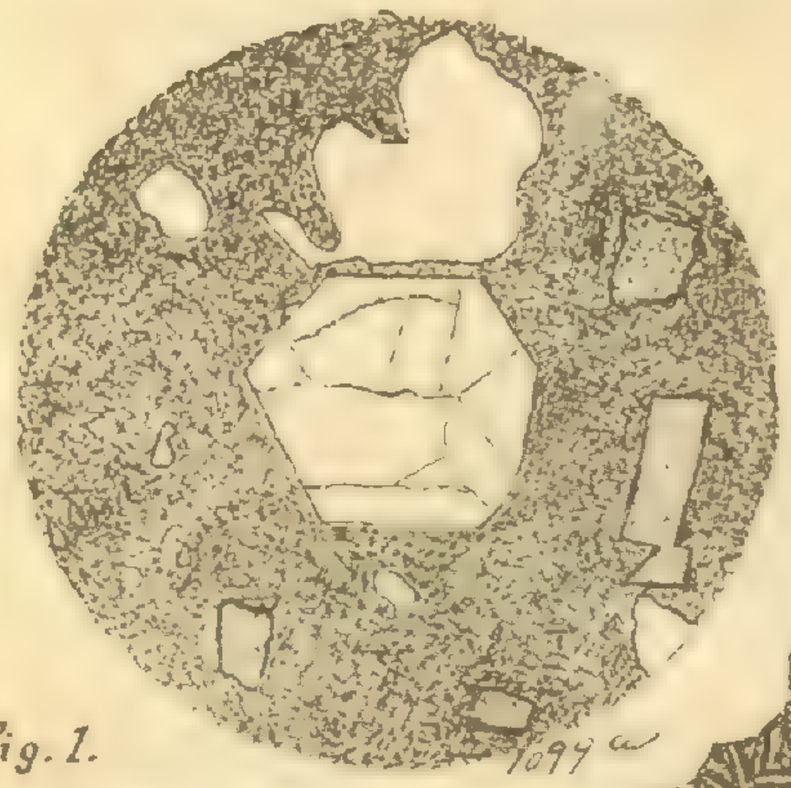


Fig. 1.

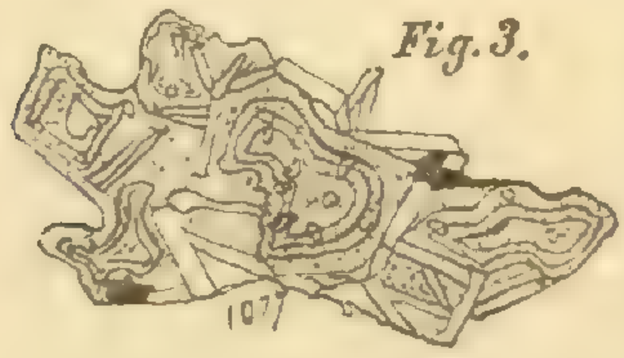


Fig. 3.

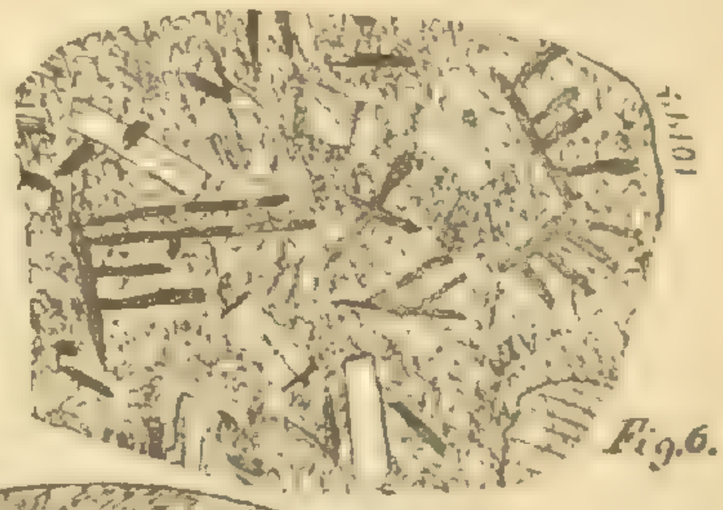


Fig. 6.

Fig. 4.

Fig. 2.

Fig. 8.

Fig. 5.

Fig. 7.

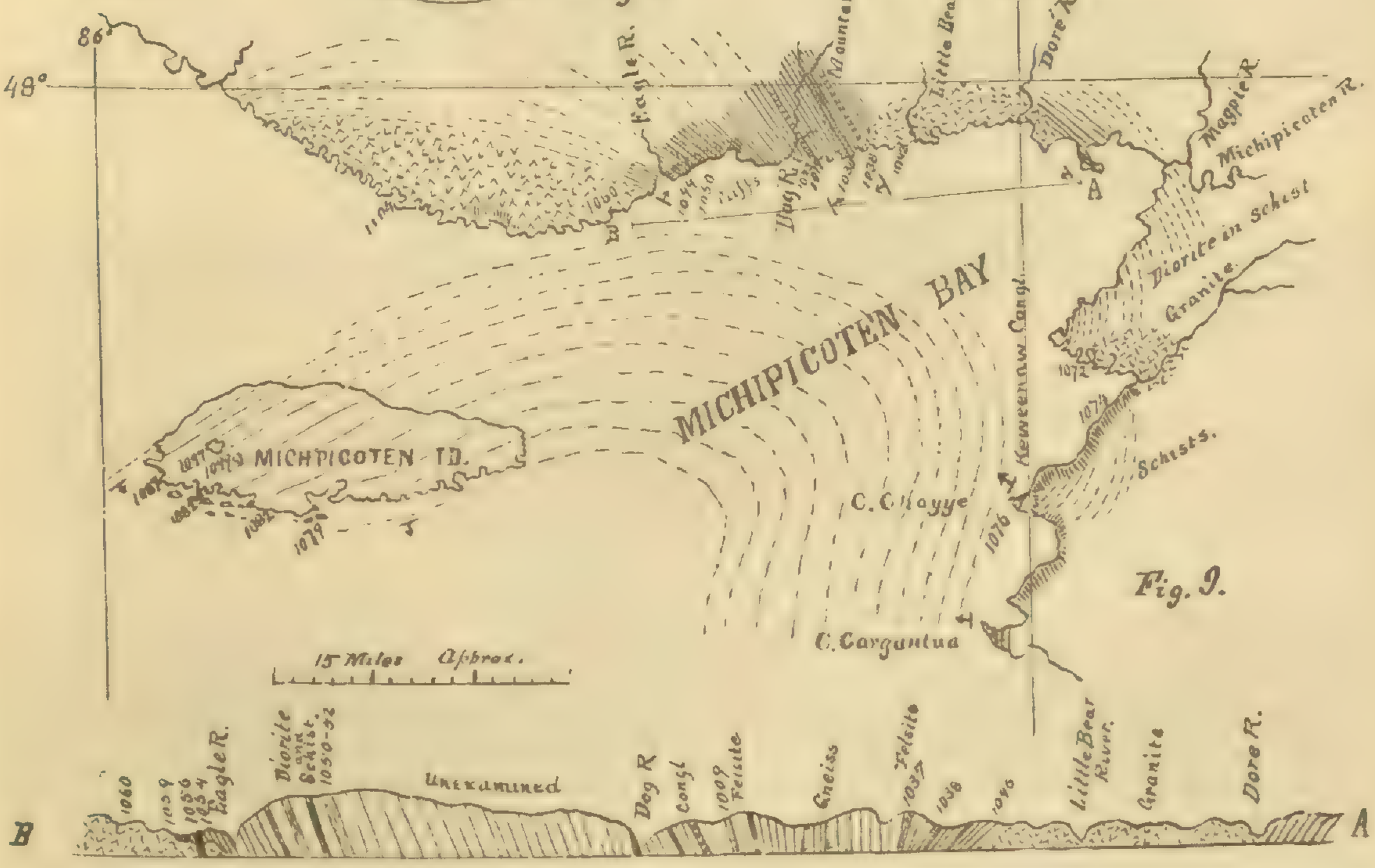


Fig. 9.

Jones & Herrick.

not present us with certain forms which should be placed with those which form the group Condylarthra."

These objects are realized with much fidelity, and the text is illustrated by a number of engravings, mostly from the casts made by Kowalevsky. The only exception to be noted in carrying out of Proposition 1 is the omission of reference to the opinion that the Condylarthra are ancestral to the lemuroids as well as to the other Ungulata.[1] The authoress gives a comprehensive review of the important paper of Dr. Schlosser (reviewed in these pages 1886, p. 719), discussing especially the genus Hyracotherium.

M. Pavlow concludes her review with the following propositions:

1. The Condylarthra is a mixed group, of which the forms present characters of Ungulata and Unguiculata, and that it should be regarded as occupying the base of the genetic tree of both ungulates and carnivores.

2. That *Phenacodus primævus* and *P. puercensis* are probably the ancestors of the Equidæ.

3. That *Phenacodus wortmani* should be excluded from this genus, and with Protogonia, which includes *Hyopsodus paulus* Leidy, should be placed among the Phenacodontidæ.

4. That Anisonchus, Haploconus, and Hemithlæus are rather the ancestors of the Carnivora; that their teeth separate them from other Condylarthra.

5. That Meniscotherium should belong to the group Propalæotheriidæ, and is perhaps synonymous with Propalæotherium.

6. That *Hyracotherium leporinum* should perhaps be regarded as the representative of the Phenacodontidæ in Europe, and that the other species of Hyracotherium should remain at the base of the genealogy of the Equidæ; and that, therefore,

7. The Condylarthra do not represent a group peculiar to America, but have representatives in Europe.

With regard to these conclusions, it may be said that the first and second are in accord with current views on the respective subjects. As regards No. 2, the difference between *Phenacodus wortmani* and the *P. primævus* is not so great as might be supposed from my figure of the superior molar teeth. The anterior intermediate tubercles of the superior molars are present, but, as they are somewhat worn in the specimen, the artist did not represent them nearly distinctly enough. Nothing but the teeth of Hyopsodus are yet known, so that its position is uncertain. It may be a lemuroid or an artiodactyle. (4) The genera mentioned

[1] Cope, Amer. Nat., 1884, 347; Origin of the Fittest, 1886, p. 343. I take occasion to remark that the omission of the Marsupialia from the direct line of phylogeny of the Condylarthra, which is justly commented on by M. Pavlow, is a pure inadvertence, as may be inferred from the text (p. 351). The error is corrected at the second reference.

have the dental characters of other Periptychidæ more or less modified, and, like them, are all constructed on a tritubercular principle. *Haploconus lineatus* is a miniature of *Periptychus rhabdodon*. The approximation of Periptychus to the Suidæ by Pavlow is made apparently in forgetfulness of this fundamental point. (5) Meniscotherium is a well-marked Condylarthron, and its characters show that foot-structures are of greater importance than those of the teeth. The latter resemble those of Pachynolophus (Propalæotherium), but the feet of the latter are unknown, and from its higher geological position it is likely to be a Perissodactyle, as it has been hitherto regarded. (6) M. Pavlow thinks that the *Hyracotherium leporinum* Owen (type of the genus) belongs to the Condylarthra. But Owen and Cope have shown close allies (one of which, *Pliolophus vulpiceps*, is thought by Lydekker to be identical with it) to be undoubted Perissodactyla. I refer here to the fact that Schlosser regards Hyracotherium as one of the Equine family, because the inner anterior cusp of the lower molars is double, forming the basis of the two cones, etc., in the same position in Anchitherium and the rest of the horse line. I wish to repeat here what I have already stated,[1] that this character *does not exist* in the American species, and is probably wanting in the *H. leporinum*.[2] It exists in some of the American species of Pliolophus, but I do not regard it as a constant character[3] in these animals. Both Kowalevsky and Pavlow think the *H. siderolitícum*, in which this character is present, should be placed in a genus distinct from the type *H. leporinum*. It is extremely different from that species in the well-developed anterior V of the inferior molars, as well as in the double anterior inner cusp. But in the American species there is every transition between the rudimental hook of the *H. craspedotum* to a V almost as well developed as in the *H. siderolitícum*. For these and other reasons I have regarded the Hyracotheriidæ as a variable family, and as the ancestors of *all* the Perissodactyla, of both the equine and tapiroid lines and others. Hence M. Schlosser may perceive the reason why I derive Lambdotherium from Hyracotherium.[4] (7) The existence of Condylarthra in Europe is to be expected. The order may have been of wide distribution in the Northern and possibly in the Southern Hemisphere, but we have as yet no evidence of its existence out of North America.—*E. D. Cope.*

Geological News.—GENERAL.—Dr. J. Walther (*Jenaische Zeitschrift*, 1887) publishes, as the result of his investigations upon the structure of the flexures on the borders of continents, the following conclusions: "The continents are generally sur-

[1] Naturalist, 1886, August, p. 720.
[2] Kowalevsky, Palæontographica, 1873 (Anthracotherium), pl. viii., f. 5–7.
[3] *Pliolophus vintanus*,—*e.g.*, Expl. S. W. 100th Mer., xlv. f. 12.
[4] Morphologisches Jahrbuch, 1886–87, p. 576.

rounded by flexures, and the course of the so-called hundred-fathom line corresponds to the descending limb of the anticlinal backbone. The region within the hundred-fathom line is composed of the edges of the beds and the rocks lying on them, and does not belong to the ocean-basins, but to the continent." The varying width of the region within the hundred-fathom line depends upon the nature of the coast and the action of the currents; thus, when a current meets a peninsula the lee side gets more transported material than the side towards which the current is turned, but under other conditions this is reversed. Barrier-reefs, says our authority, always stand upon a continental border composed of rock fragments, and the want of such a border upon the west coast of tropical America explains the absence of a barrier-reef. Coast-volcanoes mark regions of subsidence; in such regions there is a synclinal arrangement of the materials thrown up, and coast-volcanoes outside of the hundred-fathom line stand on the synclinal.

CAMBRIAN.—Dr. G. Bornemann has recently described the fossils of the Cambrian of Sardinia. Many of the forms are closely similar to those recorded by Billings from the calciferous rocks of the Mingan Islands and other localities bordering on the St. Lawrence. *Archæocyathus* Bill. is very abundant. This fossil has also lately been discovered in the Durness limestones of Scotland.

PERMIAN.—Professor Credner has recently published the results of his studies of the life-history of a Labyrinthodont, or Stegocephalian, from the "Rothliegendes" of Saxony. The species studied was that described by Credner as *Branchiosaurus amblystomus*, and by Gaudry as *Protriton petrolei*. As no less than seventy-six examples were studied, a good idea of the life-course of the creature was obtained, and it was found that in its early stages it was aquatic, breathing by gills supported by four pairs of branchial arches. By the time Protriton reached a length of 60 to 70 mm. it cast its branchiæ and became an air-breather, its development being somewhat analogous to that of the Salamandridæ of the present day. The adults measure from 100 to 130 mm. in length. During the metamorphosis many changes occur in the skeleton, the skull becomes narrower, the interclavicle increases greatly, and the pelvis shifts backwards so that six of the caudal vertebræ become lumbar.

Professor Fritsch, of Prague, has discovered a species of theromorphous reptile of the genus Naosaurus in the Permian beds of Bohemia. This genus has been found hitherto only in Texas, and was described in this journal, 1886.

TRIAS.—Professor Cope has presented to the American Philosophical Society a description and figure of the cast of the brain-

case of *Belodon buceros.* Although there is no parietal foramen of the skull, the epiphysis is so enormous as to lead to the belief that the pineal eye was present. It had communication with the orbit by a canal on each side, which Professor Cope calls the *orbitopineal* canal.

TERTIARY.—Lydekker recently described *Scelidotherium chilense*, from Tarapaca, Chili. It is characterized by extremely short nasals. He also described as new *S. bravardi*, from the Argentine Republic, a form which had previously been included by Owen with the typical *S. leptocephalum.*

POSTPLIOCENE.—The discovery at Spy, in the Belgian province of Namur, of remains of two human individuals allied to those before found at Canstadt and Neanderthal, has proved that this type of man is that of a race which lived in the age of the mammoth, the bones of which, along with those of the rhinoceros, hyæna, cave-lion and cave-bear, etc., were also found in the Spy cavern. The two skulls serve as a sort of link between the Neanderthal skull and others of the same type, which can thus be traced from Stængenes, in Scandinavia, to Olmo, in Italy. The men of Spy are described by M. Fraipont, who has made an exhaustive study of the remains, as a short, but thick-set, robust folk, walking knees foremost and bandy-legged, like the modern Lapps. The broad shoulders carried a long, narrow, and depressed head, with very prominent superciliary arches, high cheek-bones, enormous orbits, retreating brow, and receding chin,—a combination of characters not to be found in any living race, and in many points showing apian affinities.

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—In the August number of the *Geological Magazine* Mr. J. J. H. Teall[2] describes an interesting suite of hornblende rocks which occur as intrusive sheets and bosses in the limestones and quartzites of the Assynt district in Scotland. From the description which the author gives of them, these rocks appear to be somewhat similar to the camptonite of Dr. Hawes.[3] Three types are distinguished,—viz., hornblende porphyrites, diorites, and porphyrite diorites. In the last two classes hornblende is abundant in well-formed porphyritic crystals, bounded by the planes ∞P, $\infty P\bar{\infty}$, $-P$ and oP. Some of the larger of these crystals are so perfectly developed that when separated from the surrounding rock-mass their angles can be measured with a contact goniometer. Most of them are twinned according to the ordinary law, and many present fine instances of zonal

[1] Edited by Dr. W. S. BAYLEY, Madison, Wisconsin.

[2] Geol. Magazine, August, 1886, p. 346.

[3] Lithology of New Hampshire, p. 160, *et seq.*; Rosenbusch's Massige Gesteine, 1886, p. 333.

growths. In the hornblende porphyrites the hornblende crystals are less abundant. This class is characterized by the presence of feldspar in two generations. The porphyritic crystals are sharply outlined, and are developed in thick tables parallel to the clinopinacoid. They often show zonal banding, due to the variations in the optical characteristics of successive layers. The feldspar of the second consolidation occurs in grains, often forming the greater part of the ground-mass in which the crystals of hornblende and feldspar are found. In addition to these minerals, a very light-colored pyroxene is present in those sheets which are intrusive between limestone.——The same author[1] mentions another instance of the development in eruptive rocks of a schistose structure, accompanied, at the same time, by a change in mineralogical composition.[2] The normal gabbro of the Lizard peninsula in Cornwall is intrusive in serpentine and other rocks, and is itself penetrated by dykes of epidiorite. It is composed of diallage, hornblende, and saussuritized plagioclase, with here and there a little fresh olivine. The hornblende is secondary and of three varieties,—a compact brown, a uralitic, and an actinolitic variety. The saussuritization of the plagioclase and the alteration of the original augite into hornblende appear to increase as the pressure to which the rock-mass was subjected is seen to have been greater. Generally, though not always, the alteration in the composition of the rock is accompanied by a change in its structure. The massive character of the normal rock is lost, and a secondary schistose structure takes its place. These schistose rocks the author calls flaser-gabbros, augen-gabbros, and gabbro-schists. In the first the parallel arrangement of the constituents is distinct, but not so marked as to give rise to that perfect fissility characteristic of the third class. The augen-gabbros are similar in structure to the well-known augen-gneisses. These different types of structure, as well as the alteration in the original composition of the rock, the author regards as results of the action of pressure, which in some cases was so great as to give rise to faults.——The hyperesthene crystals from the hyperesthene andesite of Pokhausz, Hungary, have been isolated and examined by A. Schmidt.[3] The rock in which they occur consists of a dark gray isotropic ground-mass, in which the hyperesthene and plagioclase are scattered in porphyritic crystals. The grass-green augite of the amphibole-andesite from near Kremnitz has likewise been isolated and examined.——The igneous rocks of the Warwickshire coal-field, according to Professor Rutley,[4] are syenites, andesites (English), quartzites, diorites (both augitic and olivenitic), and tufas.

[1] Geol. Magazine, November, 1886, p. 481.
[2] *Cf.* American Naturalist, December, 1886, p. 1049.
[3] Zeits. f. Krystall., xii. p. 97.
[4] Geol. Magazine, December, 1886, p. 557.

Mineralogical News.—In 1871, Tschermak discovered that the optical characteristics of the various pyroxenes depended in great measure upon the proportion of their iron constituent. He found that with increase of iron there was a corresponding increase in the size of the optical angle, and also in the inclination of the acute bisectrix to the vertical axis of the monoclinic varieties. In later years Wiik, Herwig, and Doelter examined monoclinic pyroxenes with the view of deciding as to whether Tschermak's observations would be found to apply generally. Their results, however, were not conclusive. Very recently G. Flink[1] of Stockholm, declares, as the result of investigations made on *diopside*, *schefferite*, and *rhodonite*, that the crystallographic angle β varies with variation in the percentage of iron, increasing with the increase of this constituent and decreasing with its decrease, but within very small limits (22′). The morphotropic action of manganese is to diminish the size of the angle and to carry the crystallization of the pyroxene over to the triclinic system. The value of this angle for different proportions of manganese is given as follows:

Diopside (Mn = free).	Schefferite (MnO = 8.32 %).	Rhodonite (MnO = 41.88 %).
74° 11′	73° 53′	71° 15¾′

The optical angle and the angle of extinction in the plane of symmetry both increase with the rise in the percentage either of iron or manganese. The geometrical, optical, and chemical properties seem to show that the diopsides among the pyroxenes form a continuous series analagous to the plagioclase series among the feldspars.——In the course of the above investigation Flink had occasion to work over a large series of diopside, schefferite, and rhodonite crystals, the results of which he incorporates in his paper. On *diopside* from Nordmark, Sweden, he finds the following new forms: $\infty P\bar{5}$, $\infty P\bar{7}$, $\frac{4}{3}P\bar{\infty}$, $-2P\bar{\infty}$, $-\frac{1}{9}P$ and $\frac{1}{5}P\infty$. *Schefferite* is the name given by Mikaelson to a manganese-rich diopside from Långban. According to Flink its composition is:

SiO_2	CaO	MgO	MnO	FeO
52.28	19.62	15.17	8.32	3.83

It crystallizes in red, brown, or black crystals bounded by the planes oP, P, $P\bar{\infty}$, 2P, $\infty P\bar{\infty}$, ∞P, and —P. The habit of these is determined by the greater or less development of the three planes oP, $P\bar{\infty}$, and P. Twins are very common according to the ordinary law of the pyroxenes. The axial ratio is: a : b : c = 1.1006 : 1 : 0.59264. $\beta = 73° 53'$. In thin section the mineral is almost colorless. It possesses very weak pleochroism. It extinguishes 44° 25½′ in the clinopinacoidal section, is positive and 2Va = 65° 3′ for yellow light. *Rhodonite* usually occurs massive. But few fine crystals have heretofore been described. In the article under

[1] Zeitschrift f. Kryst., xi. p. 449.

discussion Flink mentions the fact that he has become possessed of a large collection of good crystals from Pajsberg and Långban. These he examines, and finds on them nineteen forms new to the species. The axial ratio as calculated from his measurement is: a : b : c = 1.0727 : 1 : 0.52104. The inclinations of the axes to each other are $\alpha = 76° 41' 52''$, $\beta = 71° 15' 15''$, $\gamma = 81° 39' 16''$. The plane of the optical axes is inclined to oP and $\infty'P$ at 63° and 38½° respectively. It corresponds to $\frac{3}{2}P\frac{1}{6}$, $\frac{2}{3}P\frac{1}{6}$. The acute bisectrix is perpendicular to the plane $\frac{5}{3}P\frac{1}{7}$ and is probably negative. $2Va = 76° 12'$ for sodium light and $\rho < \upsilon$ absorption $b > a > c$—. The intergrowth of minerals of analogous composition has within the past few years been proven to be very much more common than was formerly supposed. The microscope has revealed the fact that very many rock-forming minerals, as, for instance, the pyroxenes and the feldspars, very frequently occur intergrown with lamellæ of analogous but slightly different composition. The method of etched figures has shown the same statements to hold good in regard to minerals which occur only in massive form. By the latter means Baumhauer[1] has succeeded in detecting irregular intergrowth of various substances in *cloanthite* and *smaltite*. The occurrence of thin lamellæ of *ilmenite* in crystals of *magnetite* from the chlorite-schist of Greiner in the Zillerthal, is placed beyond doubt by the separation and analysis of the two components of these crystals by Cathrein.[2] ——Little *bournonite*[3] crystals cover the cubic faces of galena from Prîbram. Their long axes are either parallel to the combination edge between $\infty O\infty$ and O, or they are inclined to this at an angle of 45°.

Crystallographic News.—The twinning law of *lepidolite*[4] from Schüttenhofen, in Bohemia, is the same as that for the more common micas,—*i.e.*, the twinning plane is ∞P. The dispersion of the axes is very similar to that in the hemihedral crystals of the orthorhombic system. Intergrowths of muscovite and lepidolite take place parallel to the twinning position of micas of the same composition.——Several brief communications on the crystallography of *topaz* have lately appeared. In one H. Bücking[5] discusses the forms appearing in the topaz of Mexico, with reference more particularly to the Durango crystals.[6] A large number of new planes have been detected. A second article, by Fr. Feist,[7] describes a crystal of topaz from the Ilmengebirge.

The *Zeitschrift für Krystallographie* for the past few months has contained quite a number of short articles descriptive of single

[1] Zeits. f. Kryst., xii. p. 18.
[2] Ib., p. 40.
[3] C. Hintze, Ib., xi. p. 606.
[4] R. Scharizer, ib., xii. p. 1.
[5] Ib., pp. 424 and 451.
[6] *Cf.* also Des Cloizeaux, Bull. d. l. Soc. franç. de Min., 1886, p. 135.
[7] Zeits. f. Kryst., xii. p. 434.

crystals of different minerals from various localities. Gehmacher[1] gives a series of measurements on the faces of colorless *zircon* crystals from the Pfitschgrund, in the Tyrol.——The axial ratio of *datholite* from the Seisser Alps, as calculated by Riechelmann,[2] is a : b : c = 0.63584 : 1 : 0.6329. The angle $\beta = 89° 54'$.——The new forms $\frac{1}{40}$P, $\frac{1}{28}$P, $\frac{1}{5}$P^2, $\frac{3}{13}$P$_3$, $\frac{5}{3}$P^5, and $\frac{3}{4}$P$\frac{9}{4}$ (?) have been added to the list of planes occurring on *anatase*[3] by Seligmann.——The same investigator has measured *pyrrhotite* from the druses of basalt from the Cyclopean Islands. The results indicate that the mineral crystallizes in the hexagonal system with the axial ratio : 1 : 1 : 1 : 1.65022.——In the same article Seligmann describes a *wolframite* crystal from the Sierra Almagrera in Spain, on which are the two new forms $-2P\bar{2}$ and $-3P\frac{3}{2}$. The mineral is monoclinic with the axial angle $\beta = 90° 26'$ and the axial ratio 0.82144 : 1 : 0.87111.——New crystallographic planes have also been discovered by Sansoni[4] on calcite from Blaton, Belgium.——Sansoni[5] also mentions the fact of the tendency in *barite* crystals from Vernasca, Italy, for the prismatic and end faces to converge towards the free end of the axis to which they are parallel, and along which the crystals have their greatest development.

Miscellaneous.—The diamonds found in the African diamond-fields occur[6] in the immediate neighborhood of volcanic pipes cutting carbonaceous strata of Triassic age, and containing as inclusions pieces of the shales forming the greater part of the series, through which they break. The richest yield of the gem is obtained from the outer portion of the pipes, where the included fragments are most abundant. The rock composing the lower portion of the pipes is quite fresh. It is a peridotite of which certain portions are diamantiferous, while other portions contain no diamonds. The diamantiferous variety is crowded with fragments of shale, while the non-diamantiferous variety is free from them. From these and other facts it is concluded that the diamonds are secondary minerals produced by the reaction of the lava (with heat and pressure) on the carbonaceous shales in contact with and enveloped by them. A study of the occurrence of diamonds in other regions seems to indicate the correctness of this conclusion, as Mr. Diller[7] points out the fact that in most American localities where diamonds are known to occur the same relation of carbonaceous shales and very basic eruptive rocks has been observed to exist. Mr. O. A. Derby,[8] on the other hand, does not accept this explanation for the origin of the

[1] Zeits. f. Kryst., xii. p. 50. [2] Ib., p. 436.
[3] Ib., xi. p. 337. [4] Ib., p. 352. [5] Ib., p. 355.
[6] H. C. Lewis, Geol. Magazine, January, 1887, p. 22.
[7] Science, Oct., 1886, p. 392; also Geol. Survey of Kentucky; Report on the Geology of Elliott Co., p. 27.
[8] Science, Jan., 1887, p. 57.

diamonds of the Brazilian fields.——In the lower greensands at Flitwick and Sandy, in Bedfordshire, England, Mr. A. G. Camero[1] has found ironstone nodules filled with water, which they lose by evaporation when left exposed to the action of dry air.

BOTANY.[2]

The Growth of Tulostoma mammosum.—This odd puff-ball, which is found upon a stalk varying from one to five inches in length, occurs in abundance in the vicinity of Lincoln. I have been much interested in watching its development,—a thing by no means as easy as for many other puff-balls. One usually finds it in the Spring, in ground which had been cultivated the previous year. It often grows in clusters or groups of from half a dozen to a dozen or more, and, upon the bare ground, in the early part of the season, just after the disappearance of the snow, they are easily found. In the summer and autumn they are much more difficult to find. Last summer I was fortunate enough to discover a few clusters just as they were developing, and noted some facts which appear to be new. The ball forms under ground, and reaches maturity there,—that is, so far as its spores are concerned. Tulostoma agrees with Lycoperdon in having the interior of the ball composed of two portions,—viz., (1) a spore-bearing part occupying most of the interior, and (2) a sterile base composed of tissue which does not produce spores. Now, in Lycoperdon, if one makes a vertical section of a young ball which has nearly ripened its spores, the two parts may be very easily distinguished. In some species the sterile base is quite small, occurring merely as a greater or less thickening of the boundary tissues at the base of the ball, while in others it is well developed, notably so in *Lycoperdon cælatum*.

In Tulostoma a portion of the tissue of this sterile base remains living until after the ripening of the spores in the ball. At this time the tissue begins a rapid growth, and, as a consequence, a cylindrical stalk is quickly produced. This forces the ball through the overlying earth, and sometimes carries it up several inches. This sudden formation of the stalk reminds one of the similar growth of the stalk in the Phalloideæ, to which, indeed, as is well known to mycologists, Tulostoma is distantly related.

The stalk of Tulostoma (of this species, at least) never develops while the ball is immature. One never finds young balls upon a stalk. In fact, I have, as yet, not succeeded in finding any balls in which the spores were not well developed. This, of course, is due to their subterranean habit. I doubt not, however, that the details of their early development are essentially like

[1] Geol. Magazine, August, 1886, p. 381.
[2] Edited by Prof. CHARLES E. BESSEY, Lincoln, Nebraska.

those of other puff-balls. Their greatest difference is that just pointed out, whereby the sterile base develops a stalk after the ball has matured its spores.—*Charles E. Bessey.*

Ash-Rust again.—It will be remembered that I called attention, two years ago, to the great abundance of the Ash-Rust (*Æcidium fraxini* Schwein) upon the Green Ash (*Fraxinus viridis*) in Lincoln. Last year I noted the fact that this rust was very rare in the same locality. This year the rust is, if anything, still more rare than last year. I have seen scarcely any leaves affected by it, and have had but few specimens brought to me by a large class of efficient student collectors. It is difficult to suggest an adequate explanation of the sudden disappearance of what threatened in 1885 to be a very serious pest to the Green Ash. The trees were badly affected in 1884 also, as I noticed about the 1st of July, while on a visit of a few days to the city. I have no data earlier than that year. The record thus far is as follows: 1884 and 1885, ash-rust abundant; 1886 and 1887, ash-rust rare.—*Charles E. Bessey.*

Vitality of Buried Seeds.—On May 25, 1886, I buried the following seeds five feet deep in light, sandy soil, at Grand Rapids, Mich.: white oats, common white beans, Stowell's evergreen sweet-corn, Hathaway dent-corn, and buckwheat. All were grown in 1885, and had percentages of germination in good, sandy garden-soil varying from 87 to 94. One hundred seeds of each were mixed with sand and placed in separate, open, tin cans, with the openings downward. On May 22 of this year (1887) I had them examined. All were dead. A little of the sweet-corn had sprouted; most of the dent-corn had grown about three inches in length, having roots that filled the can. The other seeds had decayed without germinating.—*A. A. Crozier, Department of Agriculture, Washington, D. C.*, June 3, 1887.

The Study of Lichens.—"To the American student the study of lichens presents peculiar difficulties. Some of these are (1) the want of any work containing the descriptions of all known lichens; (2) the difficulty of procuring the works upon lichens, and the fact that they are mostly in foreign languages,—Latin, German, French, etc.,—and that many useful works are published in the proceedings of learned societies, and are not to be consulted here; (3) the embarrassment arising from the multiplicity of systems, and the differences of opinion as to the limits of genera and species; (4) the vast synonymy, which renders it often difficult to decide as to the proper name of a plant; (5) the extent and variety of our own lichen-flora, and the incompleteness of the work of our great authority, Tuckerman."

The foregoing quotation is from an interesting little work, entitled "An Introduction to the Study of Lichens," by Henry Willey, of New Bedford, Mass., which is intended to help the beginner over some of the above-mentioned difficulties, as well as to lay a broad foundation for good work. Five pages of the book are devoted to the collecting and preservation of lichens. Ten pages are given to the structure and organs of lichens; two and a half to the distribution of North American lichens; four to the history of lichens; two to bibliography; and twenty-eight to their systematic arrangement. The ten plates which are added will be very helpful to the student.

A slip of the pen, which can easily be corrected, occurs on page 11, where a lichen is said to be "a cryptogamic plant of the order [*sic*] Thallophytes." Class, or Branch, was evidently intended. In the fifth chapter it would have been well, perhaps, to have referred to a distribution of sets of New England lichens begun eight or ten years ago by Dr. Halsted, but soon abandoned. Reference should also have been made to the excellent introduction to the study of the structure and development of lichens in Sach's "Text-Book of Botany," Goebel's "Classification of Plants," and the article "Lichens," by the Rev. James M. Crombie, in the fourteenth volume of the ninth edition of the "Encyclopædia Britannica."

Cannot the botanists of the country prevail upon Mr. Willey to undertake the task of preparing sets of North American lichens? There can be little doubt as to the success of such an undertaking.—*Charles E. Bessey.*

Botanical News.—The "List of Works on North American Fungi," published in the *Harvard University Bulletin*, No. 37, by Professors Farlow and Trelease, is a most valuable aid to the student of the fungi. The list extends from A to H, and already includes three hundred and thirty-eight entries. The remainder is promised soon.——A book which will prove useful in the herbarium is announced by Merzbach & Falk, Rue des Paroissiens, 18, 20, 22, Brussels. It bears the title of "Index Generum Phanerogamorum," and will form an octavo volume of about six hundred and fifty pages. The subscription-price is twenty francs.——A new journal, the *Annals of Botany*, is announced in England. It "will resemble the well-known *Quarterly Journal of Microscopical Science*," and will be printed and published by the Clarendon Press, Oxford. Many eminent English botanists have given the project their support, and in this country the names of Professors Gray and Farlow appear as promising their support. The subscription-price will be twenty-one shillings per volume.——From the *Bulletin of the California Academy of Sciences* we have a paper by Dr. C. C. Parry on the Pacific Coast Alders, and one by Professor E. L.

Greene, entitled "Studies in the Botany of California and Parts Adjacent."——Dr. Halsted's *Bulletin of the Iowa Agricultural College*, from the Botanical Department, contains many things of interest, from methods of work and study in the class-room and laboratory to scientific descriptions of species.——Dr. Vasey has recently issued a pamphlet of sixty-three pages on the "Grasses of the South." It forms Bulletin No. 3 of the Botanical Division of the Department of Agriculture at Washington. Aside from its high value to the agriculturists of the South, it possesses a good deal of botanical interest.——The weeds of Southwestern Wisconsin have been listed and discussed by L. H. Pammel in a twenty-page pamphlet, which has just appeared.

ZOOLOGY.

Radiolaria.—By far the most important contribution to our knowledge of the Protozoa within recent years is the report on the Radiolaria of the "Challenger" expedition, just published by Professor Ernst Haeckel, of Jena. A summary of these nearly two thousand pages and one hundred and forty quarto plates is impossible. We can but indicate something of their scope. Professor Haeckel now restricts the limits of the Radiolaria more than formerly. As he now defines them they are "Rhizopoda with central capsule and calymma," for, as he says, their most important character is the fact that the unicellular body is always in two main portions, an inner central nucleated capsular and an extra-capsular non-nucleated portion, the calymma, the two being separated by a capsule-membrane. The majority have a skeleton, usually of silica, but frequently of organic substance (acanthin), and this may take the most beautiful shapes imaginable. The present report embraces not only the Radiolaria taken by the "Challenger" collections, but is a complete monograph of all known species, and has employed Professor Haeckel's time for ten years. The classification now adopted varies considerably from that of his monograph "Die Radiolarien" of 1862. It divides the group or class into two sub-classes.

Sub-Class I.—Porulosa. Central capsule primitively a sphere, and retains this homaxon form in the majority of species. The membrane of the central capsule is everywhere perforate, but possesses no larger osculum. The pseudopodia radiate in all directions, and in great numbers, passing through the openings in the capsular membrane. To this sub-class belong two legions,—1, Peripylea, or Spumellaria, with six orders, and, 2, Actipylea, or Acantharia, with four orders.

Sub-Class II.—Osculosa. Central capsule originally monaxon (ovoid or spheroidal), retaining this condition in most species. The membrane of central capsule with a single large osculum at the base of its vertical main axis. Pseudopodia radiating from the sarcode streaming from the osculum. This also contains

two legions,—1, Monopylea, or Nassellaria, with six orders, and, 2, Cannopylea, or Phæodaria, with four orders.

The immense amount contained in this work can be readily seen from the fact that these twenty orders are in turn subdivided into eighty-five families, seven hundred and thirty-nine genera, and four thousand three hundred and eighteen species; but large as these numbers are, Professor Haeckel doubts if they include half of the recent species. The ancestral group from which all the others are probably derived is the spherical Actissa, the most ancient stem form of the Spumellaria. The literature of the Radiolaria is not very extensive, only sixty titles being catalogued from 1834 until the present date. In the bibliography is a "Phaulographic Appendix," a division which embraces "absolutely worthless literature," a feature which might well be adopted in other bibliographies. The beautiful plates which illustrate the volume show what a field there is in these minute forms for the artist.

Ctenodrilus parvulus.—Under this name Dr. Robert Scharf describes[1] a new species of Oligochæte worm, probably from some part of the British coast, though the exact locality is unknown. The species differs from the two species (*Ct. pardalis* and *Ct. monostylos*) in its smaller size, having but from seven to ten segments, and a total length of about 4 mm. It has but one kind of setæ, which are not pectinated, and it differs from *monostylos* further in lacking the peculiar tentacle found in that form. Scharf concludes that the number of setæ in a bunch is not a good diagnostic character. There is but a single pair of nephridia, which lie in the head. As in the other species the nervous system lies entirely in the ectoderm, and in some regions it is difficult to say where epidermal cells end and nerve-cells begin. No traces of reproductive organs were found, the only mode of reproduction being that by fission, which took place much as described by Kennel in *Ct. pardalis*. A bud is formed between two segments, and, in contradistinction to the Naidæ, these buds are formed in the same order that the new segments are formed, —*i.e.*, from in front backward. The first three segments never show any signs of budding, nor do the last two or three. The buds appear on the anterior dorsal margin of each segment, the segmentation of the body becomes deeper, and soon the body divides, the resulting portions developing the parts necessary to make them perfect worms. The process occupies about forty-eight hours.

Balanoglossus Larvæ.—Mr. W. F. R. Weldon gives a preliminary account of two Balanoglossus larvæ (*Proc. Roy. Socy.*, No. 253) which he obtained in the Bahamas, and which differ

[1] Quarterly Jour. Micros. Sci., xxvii., March, 1887.

considerably in their later development from those described by Bateson (*vide* AM. NAT.). The earliest stage had but a single transverse groove, but the later stages seem readily homologous with Bateson's form up to the time of the appearance of a pair of rudimentary gills. From this point the majority of the specimens undergo a gradual process of degeneration, accompanied by considerable increase in size. The proboscis itself becomes grooved on either side, each groove being provided with short, broad tentacles, while the circular post-proboscidean groove nearly disappears. Internal changes also occur, involving the disappearance of both notched and gill cavities, and an extensive degeneration occurs in the nervous system. The conclusions drawn are, "that there is fair ground for the belief that the organisms described are Balanoglossus larvæ, which for some cause or other have been unable to develop adult characters, and have therefore varied," a probable cause being the drifting of the larvæ into deep water by the action of currents and winds. If this be true, it follows: 1, that in some cases at least heredity can work only on the application of stimuli afforded by particular surroundings; 2, that some larvæ without stimuli are highly variable; 3, that variations produced by a given change may be uniform and definite in character; and, 4, these changes may produce not the modification of ancestral characters, but a hypertrophy of those which are purely larval.

The Glands in the Foot of Nudibranch Molluscs.—Dr. J. H. List gives the result of his studies of the foot of *Tethys fimbriata* (*Zeit. wiss. Zool.*, xlv.). After a few remarks upon the histological structure of connective tissue, muscles, and epidermis, he gives a detailed account of the glands. He recognizes in the upper surface, 1, unicellular mucous glands; 2, unicellular glands with fat-like contents (phosphorescent in function?); 3, unicellular glands with peculiar, frequently laminated contents; and, 4, unicellular glands with coarsely granular contents. On the under surface occur, besides beaker-cells and Nos. 1, 2, and 4 of the upper surface, polynuclear glands, resembling those described by Leydig as pigment and calcareous glands in the feet of terrestrial gasteropods. As in those cases, these latter glands are connected with the connective-tissue cells. Here, however, they contain neither pigment nor lime.

Fresh-Water Crustacea.—Mention should have been made before of Professor L. M. Underwood's "List of the Described Species of Fresh-Water Crustacea from America, north of Mexico," which appears in the second volume of the *Bulletin of the Illinois State Laboratory of Natural History*. It is more than its name implies, for it includes the Oniscidæ, which are terrestrial, as well. The total number of species enumerated is nominally

three hundred and thirteen, but doubtless many of these will be found to be synonymes, while there are some omissions to be expected in the pages. A tolerably complete bibliography completes the article. At a casual glance, however, the following titles are noted as not occurring in the list, and are mentioned here so as to make it more complete. All have references to terrestrial or fresh-water forms in the region embraced in the original paper:

Abbott, C. C., "Notes on the Habits of Certain Crawfish," AM. NAT., vii., 1873.

Cooper, J. G., "Report on the Crustacea," "Pacific R. R. Survey," vol. xii., pt. ii., 1860.

Faxon, W., "On the so-called Dimorphism in the Genus Cambarus," *Am. Jour. Sci.*, January, 1878.

Haldeman, S. S., "Crustacea in Baird's Translation of Hoeck's Iconographic Encyclopædia."

Harford, W. G. W., "Description of a New Genus and Three New Species of Sessile-Eyed Crustacea," *Proc. Cal. Acad.*, vii., 1876.

Hay, O. P., "Description of a New Species of Crangonyx." Printed for the author, June 2, 1878.

Harlan, Richard, "Description of a New Species of the Genus Astacus," *Am. Phil. Trans.*, n. s., i., 1830.

Herrick, C. L., "Habits of Fresh-Water Crustacea," AM. NAT., October, 1882.

Herrick, C. L., "Types of Animal Life, Pt. I., Arthropoda." Minneapolis, 1883.

Ingersoll, Ernst, in "Annual Report U. S. Geol. Geog. Survey of Territories for 1874," pp. 387, 388.

Kingsley, J. S., "Synopsis of North American Species of Alpheus," *Bulletin U. S. Geol. Survey*, vol. iv.

Kingsley, J. S., "Carcinological Notes, V.," *Bulletin Essex Inst.*, xiv. p. 105.

Lockington, W. N., "Thalassinidæa and Astacidea of the Pacific Coast," *Annals and Mag. Nat. Hist.*, October, 1878.

Lamarck, P., "Hist. Nat. Animaux sans Vertèbres."

Packard, A. S., "Structure of the Brain of Sessile-Eyed Crustacea," "Memoirs Nat. Acad. Sci.," iii.

Rathbun, R., "Shrimp and Prawn Fisheries of the U. S.," *Bulletin Fish Commission*, 1882.

Rathbun, R., "Collection of Economic Crustaceans, etc., at Fisheries Exhibition, Washington, 1883."

Ryder, J. A., "Successive Appearance of Chirocephalus and Streptocephalus," AM. NAT., p. 703, 1879.

Stuxberg, A., "Tvenna nya Oniscider," *Ofversigt. Vet. Akad. Forh.*, Stockholm, 1872, No. 9.

Dr. O. E. Imhof, after a careful collection of the microscopic fauna of the Alpine lakes of Europe, states that the great nia-

jority of the fresh-water basins up to two thousand metres harbor a pelagic fauna very rich in individuals. Some of the lakes at higher elevations are also well supplied. From seven to sixteen species appear usually in each lake up to seventeen hundred and ninety-six metres. The most widely and generally distributed genera are Daphnia, Cyclops, and Diaptomus.

Tropidonotus clarkii B. G., in Southern Louisiana.—Early in June, 1886, the writer had occasion to collect on the salt marshes at Grand Isle, Louisiana. This island is on the Gulf coast at the entrance of Barataria Bay, about forty miles west of the mouth of the Mississippi. Here Clark's water-snake (*Tropidonotus clarkii*) was not uncommon, as several were seen daily, and one or two were secured for identification.—*A. K. Fisher, M.D., Washington, D. C.*, June 7, 1887.

Spelerpes guttolineatus Holbrook, in the Vicinity of Washington, D. C.—On April 10, 1887, Mr. H. W. Henshaw and the writer spent the greater part of the day collecting in the vicinity of Munson Hill, Va., a locality not more than five or six miles in an air-line from the city of Washington.

The surface of the country is very much broken by numerous hills and valleys. The hills and ridges are covered for the most part with pines, while the valleys support a growth of deciduous trees, many of which are of large size.

In a spring at the edge of one of the principal valleys, we were fortunate enough to capture two specimens of *Spelerpes guttolineatus*. According to Professor Cope, who kindly examined the specimens, this locality is several hundred miles north of the known range of the species.

The following species were also found in the same spring: *Spelerpes bilineatus*, *Spelerpes ruber*, *Plethodon erythronotus*, and *Desmognathus fusca*.—*A. K. Fisher, M.D., Washington, D. C.*, June 7, 1887.

Muhlenberg's Tortoise (Chelopus muhlenbergii Schweigger), at Lake George, N. Y.—At Lake George, during the summer of 1883, frequent excursions were made across a large Sphagnum marsh, located at the head of Dunham's Bay, and covering several hundred acres.

On nearly every trip the shells of one or more Muhlenberg's turtles were found. It is difficult to reach any satisfactory conclusion as to the cause of death of these turtles, as the shells were not mutilated in the least, though the flesh had evidently been eaten by something.

The occurrence of this southern species in this locality is especially interesting when taken in connection with the presence of such birds as the Large-billed Water-thrush (*Seiurus motacilla*)

and Dove (*Zenaidura macrura*), and of such southern trees as the Dogwood (*Cornus florida*) and Sour-gum (*Nyssa multiflora*), for it tends to show how decidedly this low valley differs from the immediately adjoining border of the Adirondacks region in being Carolinian in its fauna and flora (as already pointed out by Dr. Merriam, "Mammals of the Adirondacks," pp. 11, 12).—*A. K. Fisher, M.D., Washington, D. C.*, June 7, 1887.

Zoological News.—CŒLENTERATES.—Fewkes has described a new medusa from New Haven, under the name *Nectopilema verrillii*. This jelly-fish belongs to the Pilemidæ, and its nearest relatives are Pilema and Rhopilema, with affinities pointing towards Polyrhiza. It is about eighteen inches in diameter, rich, deep brown in the oval cylinder and frills, the umbrella translucent bluish-white.

CRUSTACEA.—H. L. Osborn begins in the May number of the *Amer. Mo. Micros. Jour.* a series of articles on the histology of the crayfish, the first dealing with the green gland.

At a recent meeting of the Linnæan Society of London, Mr. A. O. Walker gave an account of a large collection of Crustacea obtained at Singapore during the years 1879–1883. Several new species of Decapods are described.

Professor H. L. Osborn's article on the Osphradium of Crepidula, to which reference was recently made, has been reprinted in the *Amer. Mo. Micros. Jour.*, viii., pp. 60–64, with illustrations which render the description more readily followed.

WORMS.—Messrs. Gibson and Chalmers, of Liverpool, have come to the conclusion that the so-called hepatic cells of Lumbricus are digestive glands rather than "vasifactive tissue," as has been suggested.

FISHES.—From the Andes of the United States of Colombia G. A. Boulenger describes three new Siluroid fishes.

C. H. Eigenmann and Jennie E. Honing, in their review of the Chætodontidæ of North America, published in the *Annals and Magazine of the New York Academy of Sciences*, admit three genera—Prognathodes, Chætodon, Pomacanthus—and fourteen species of the family.

REPTILIA AND BATRACHIA.—G. A. Boulenger has recently described a new frog of the genus Megalophrys (*M. fœa*), a single specimen of which was procured east of Bhamò, Burma. The head is enormous, nearly twice as broad as long. There are now four species in the genus.

G. A. Boulenger's synopsis of South African snakes contains fifty species, including six Typhlopidæ, only one Python, twenty-six Coluebridæ, ten Elapidæ, and seven Viperids.

G. A. Boulenger has recently described, in the *Ann. and Mag.*

Nat. Hist., a new Rana, three Bufos, and *Phrynella pulchra*, all from Malacca.

MAMMALS.—According to Dr. J. B. Sutton, animals are not free from certain diseases thought to be referable in man to his erect position. One-fourth of the female monkeys dying in the London Zoological Gardens have displacement of the uterus, and the same disease occurs in the lioness, tapir, Cape hunting-dog, pygmy hog, antelope, etc., and in domesticated mammals. Two cases of inguinal hernia in monkeys are recorded, and the disease is said to be common in horses.—*P. Z. S.*, April, 1886.

Balænoptera borealis, or Rudolphi's Rorqual, the "Sejhval" of the Norwegian whalers, proves to be a sufficiently common species, though scarcely known before 1882. In 1885, most of the whales caught along the Finmark coast were of this species. Its average length is about forty-four feet. It is less robust than *B. rostrata*, and may be recognized in the sea by its high, black dorsal fin, more slender head, and more rounded snout. The color is dark gray-blue, except that the belly is more or less white as far as the genitalia. Both sexes seem to attain about the same size; if there is any difference it is in favor of the female. The flippers are slender and pointed, and relatively shorter than in any other species. A new species of Echinorhynchus (*E. ruber*) usually infests the intestines in great numbers, the copepod (*Balænopterus unisetus*) occasionally infests the baleen-plates, and a true ecto-parasite (undescribed) is also occasional. The stomachs of the specimens examined were filled with the remains of the copepod *Colarius finmarchicus*.

The species of Capra, according to Mr. P. L. Sclater, are confined to the following localities: *C. pyrenaica*, to the Pyrenees, Central Spain, and the higher ranges of Andalusia and Portugal; *C. ibex* (the Steinbok), to the Alps of Switzerland, Savoy, and the Tyrol; *C. ægagrus* (the Wild Goat), to Crete and some of the Cyclades in Europe, and through the mountains of Asia Minor and Persia to Sind and Baluchistan; *C. pallasi*, to the Caucasus; *C. sinaitica*, to the mountains of Upper Egypt, the Sinaitic peninsula, and Palestine; *C. walie*, to Abyssinia; *C. sibirica*, to the Altai and the Himalayas; *C. falconeri* (the Markhoor), from the Pirpanjal range, south of Cashmere, into Afghanistan and Gilgit on one side, and the Sulemani range on the other; *C. jemlandica* (the Tahr), to the Himalayas, from Cashmere to Bhotan; and *C. hylocrius*, to the Neilgherries, Anamallays, and other ranges of Southern India.

EMBRYOLOGY.[1]

The Development of Spiders.—The Arachnids are receiving considerable attention recently at the hands of embryologists.

[1] Edited by Prof. JOHN A. RYDER, Biological Department, University of Pennsylvania, Philadelphia.

The latest paper to be recorded is that of Schimkewitsch,[1] on the development of several species of spiders, the main features of which were outlined in a preliminary paper in the *Zoologischer Anzeiger* for 1884. After describing the envelopes of the egg and the composition of the yelk (of which he recognizes three kinds), he proceeds to the segmentation. In this he is inclined to follow Ludwig rather than other observers in the recognition of a central segmentation and a migration of some of the cells to the surface to form the blastoderm, while others remain behind in the yelk, where, in the shape of polynuclear yelk-masses, they represent and finally result in the endoderm. After the formation of the blastoderm, three processes occur nearly simultaneously,—the breaking down of the yelk-pyramids, the concentration of the primary ectoderm, and the formation of the mesoderm, these being individual variations in the species studied. The concentration of the primary ectoderm consists in a flattening and consequent expansion of the cells on one side of the yelk, while on the other they become thicker and more cylindrical, thus giving rise to the germinal area. Although Schimkewitsch appears to be unaware of this fact, this process is paralleled in many Arthropods, and was commented upon at some length by Mayer (*Jenaische Zeitschrift*, xi., 1877). According to Schimkewitsch, the mesoderm arises, in some species, from the blastoderm, in others by budding from the entoderm. His figures, however, all seem reconcilable with the view that they all arise from the blastoderm. The primitive cumulus is, according to Schimkewitsch, the anal lobe, while the "white spot" of the "comet-stage" forms the cephalic lobes,—conclusions somewhat at variance with those of Morin[2] and Locy, the latter reversing the ends of the embryo

The account of the external development adds but little to our previous knowledge, the principal points being that the mandibular segment is budded from the cephalic one, that Croneberg's antennæ are the rudiments of the upper lip, and that no appendages are developed at any stage upon the first abdominal segment.

In the internal development there are more points to be noticed. The splitting of the mesoderm begins in the fifth segment of the body. At first the resulting cœlomatic cavities are distinct, but soon they run together in the thoracic segments. At about this stage begins the formation of a secondary entoderm, composed of cells budded from the polynuclear yelk-masses, and taking a peripheral position in the yelk. These, thinks Schimkewitsch, may possibly be the yelk-mesoderm of Balfour; but our author does not make it clear how they then pass through the splanchnopleure and take a position in the body

[1] Archives de Biologie, vi. pp. 515–584, pls. xviii.–xxiii., 1887.
[2] *Cf.* Am. Nat., xxi. p. 294, 1887.

cavity; nor do his statements seem conclusive that they give rise to the blood-corpuscles and the fat-bodies. The fact that the cells which he finds in the pericardium may originate from the entoderm and may form blood-corpuscles is not so doubtful. From the somatopleure he derives (1) all the muscles of the body except those of the mid-gut *si elle existe;* (2) the aponeurotic layer of the cephalothorax; (3) the membranes of the fore and hind guts, of the tracheæ and glands, and of a portion of the genital ducts,—that is, of all organs derived from an ectodermal invagination; and (4) the sarcolemma and neurilemma. From the splanchnopleure are developed (1) the envelopes of the mid-gut, (2) the genital organs, (3) the pericardium and the pulmonary veins, while the dorsal mesentery gives rise to (1) the heart, (2) the lateral arteries, and (3) the suspensors of the heart.

As will be seen, Schimkewitsch accepts the idea of Bütschli, that the cavity of the heart corresponds to the segmentation cavity, and that its walls are derived from the two moities of the mesentery,—facts which explain the communication of this organ with the yelk. The splanchnic mesoderm encroaches upon the yelk, dividing it into lobes, which persist in the lobes of the liver. The epithelium of the mid-gut begins to form first behind, that of the liver being at first formed of two kinds of cells,—one representing the true hepatic, the other ferment, cells. At the time of hatching no genital openings are developed, but the genital glands bend downwards at their anterior extremities, and this decurved portion represents the mesodermic portion of the genital duct.

Of the ectodermal structures we need only to say that the account of the development of the eyes is at variance with the results of Locy, and then turn to the lungs and nervous system. Regarding the discussion of the former and their homologies with the branchiæ of Limulus, our author seems as much at sea as he did in his former paper[1] on the anatomy of Epeira. He says that at first the lung is a bunch of tracheæ, but his sole figure of the embryonic lung exactly parallels in its structure the early gill of Limulus. The early gill-book and lung-book (not the stigma, etc.) could have been drawn the one from the other without one's being able to detect the difference.

The first appearance of the ventral cord is by two thickenings near the median line, which from the first have a segmented character. Later, they become widely separated, as a result of the reversion of the embryo. The rudiments of the brain are at first distinct from each other, and from those of the ventral cord. The ganglia of the cephalothorax are cephalic, rostral, mandibular, and maxillary, one pair each, while the pedal ganglia number four pairs. His sections show the cephalic invaginations described by Balfour, but he gives no suggestions as to their fate

[1] Ann. Sci. Nat., VI., xvi., Art. I., pp. 67 and 84, 1884.

in the adult. The cephalic ganglia give rise to the optic nerves; the rostral ganglia, which occupy a place on the supero-lateral face of the supra-œsophageal ganglia, are compared with the labial ganglia described by Tichomiroff in Bombyx, while the mandibular ganglia, which also enter into the composition of the brain, give rise to the sympathetic nerve.

The speculations which conclude the article, as to the homologies of the nervous system in various Metazoa, are not equal to the rest of the paper.—*J. S. K.*

MICROSCOPY.[1]

Method of Staining and Fixing the Elements of Blood.[2]—Recent discoveries of morphological elements in the blood hitherto unknown, as well as the newly published facts concerning its coagulation, have aroused an interest in the subject which calls for an acquaintance with the methods with which it is possible to follow those results. Accordingly, I would like to describe the method employed in this laboratory; for, although it has been mentioned by Professor Gaule in his lectures for several years, it has not as yet been published.

The methods formerly used were that of examining fresh blood and that, perfected by Ehrlich, which consisted in staining dried blood.

Our method consists in a series of manipulations requiring only thirty-five minutes for their completion.

The following is a list of the reagents, together with the length of time and the order in which each is to be used:

	Min.
1. Corrosive sublimate (concentrated solution)	6
2. Distilled water	1
3. Absolute alcohol	5
4. Distilled water	1
5. Hæmatoxylin (½ per cent. alum solution to which, for every 100 c.cm. employed, 20 drops 5 per cent. alcoholic solution have been added)	6
6. Distilled water	1
7. Nigrosin (½ per cent. water solution)	1
8. Distilled water	½
9. Eosin (1 gr. eosin dissolved in 60 c.cm. alcohol; 140 c.cm. distilled water)	2
10. Alcohol	5
11. Oil of cloves	1–2
12. Xylol.	
13. Canada balsam (diluted with xylol until it readily flows).	

As receptacles for these fluids, each person has upon his table

[1] Edited by C. O. Whitman, Milwaukee, Wisconsin.

[2] From the Physiological Laboratory at Zurich.

three shallow glass dishes with flat bottoms, so large that a slide may be easily put in and taken out of them. Into the first of these we pour corrosive sublimate, into the second distilled water, and into the third absolute alcohol. It is necessary either to label the dishes or to place the two not at the moment in use at one side. For the coloring fluids we use bottles whose stoppers serve at the same time as droppers or pipettes. The most convenient form has a glass stopper, which is hollow and drawn out into a fine point below, while above it broadens into a funnel with a lip whose opening is closed by a rubber membrane. A slight pressure upon the membrane causes, upon the removal of the finger, a rise of fluid in the funnel, which, upon the removal of the stopper from the bottle, can be at pleasure dropped upon the slide. For oil of cloves, xylol, and Canada balsam wide-mouthed bottles are used. In the first two bottles are brushes; in the last, the ordinary glass rod. Other necessary utensils are a glass rod, sharp-pointed scissors, clean slides and cover-slips, filter-paper, twine or coarse thread, a small bottle of absolute alcohol, a sharp, clean needle, a fine clean rag, and a hand-towel.

Aside from these, a board, fifteen by five inches, with two pair of holes, large enough for a piece of tape to pass through double, is an essential help. The first pair of holes should be four inches distant from the second, and the two holes of each pair one and a half inches apart. The tape should be so passed through the holes that there will remain upon one side of the board loops, on the other long ends, by which, upon passing the extremities of the frog through the loops, one may easily and firmly tie the frog upon the board. Such preparation is necessary, otherwise the manipulations cannot follow one another quickly enough. After these preliminaries have been completed, the labelled bottles being placed within reaching distance, the distilled water and alcohol in front of these, and the corrosive sublimate nearest of all, we are ready to bind our frog upon the above-mentioned board and begin our preparation. We make use of the frog for this purpose at first, since its blood coagulates less quickly than that of mammals. The vena femoralis, which may be seen as a dark blue line below the knee-joint on the inner side of the leg, having been snipped, we quickly bring with a glass rod a drop of the blood which comes from the wound upon a slide previously moistened by the breath, and throw the whole into the dish of sublimate for six minutes. If a little care is taken to spread out the drop of blood in putting it on the slide, the result is more satisfactory. Brought from the sublimate into the dish of water, we find that the greater part of the blood adheres to the slide. The superfluous sublimate being washed from the preparation during the moment that it remains in the water, we next partially dry the slide by resting it upon filter-paper before dropping it into the alcohol bath. The slide, which has remained in alcohol

six minutes, is brought again into distilled water for half a minute, since our coloring fluids are water solutions. The hæmatoxylin is then dropped upon the slide, and removed again at the end of six minutes by resting the edge of the slide upon filter-paper, and afterwards washing with distilled water for one minute. The same process follows with the nigrosin and eosin, the first remaining upon the slide for one minute, the second two minutes. From the eosin we bring the preparation directly into alcohol, since the eosin is partially an alcohol solution. At the end of five minutes the slide is taken out of the alcohol, and, in order to be quite sure that there is no water still clinging to the preparation, we incline the slide at a slight angle to the rag with which we are holding it, and pour a few drops of alcohol from the small bottle over it. If upon dropping oil of cloves on the preparation it should be dark upon a dark sleeve or other dark background, we may remove the oil of cloves with a few drops of xylol. Having quickly cleaned the slide close up to the preparation, we place a drop of Canada balsam upon it, which must be allowed to spread out before the cover-slip is lowered upon it.

Human blood is prepared in the same way, except that here the finger-tip undergoes the surgical operation. If a finger of the left hand be lightly bound with a string and a sharp needle be held in the right a quarter of an inch from the end, one quick energetic stroke suffices to bring a drop of blood to the surface, which should be transferred to the slide by drawing it, previously moistened, across the drop of blood.

A look at our preparations with the microscope shows us that the coloring substances we have used have attached themselves to certain parts and certain forms of corpuscles. In the preparation of the frog's blood we find that the large oval red corpuscles have been colored red with eosin. The nuclei are for the most part blue from hæmatoxylin, the well-known coloring substance for nuclei. The protoplasma, provided no coagulation has occurred, is homogeneous. The usually oval nuclei are also generally homogeneous, though occasionally granulated like the nuclei of other cells.

The white blood-corpuscles differ among themselves in form, color, and the number and size of their nuclei. 1. Those coarsely granulated which are deeply colored with eosin, hence their name "eosinophilous cells,"[1] are perhaps the most striking. Their form is usually round, and they contain from one to four nuclei. 2. A second kind is perhaps best characterized by its large nucleus sparely surrounded with protoplasma, colored blue with nigrosin. The form of the cell, according to the position in which we see it, is spindle-shaped, with an oval nucleus in which the granules

[1] This name was given by Ehrlich.

are distinct, and seem to be arranged in lines parallel to the long axis of the nucleus, or it is quite round with a round nucleus. The name "hæmatoblasts" was given them by Hayem. 3. Another variety has, like the "eosinophilous cells," several nuclei. Its protoplasma is, however, blue like that of the "hæmatoblasts," its form irregular, recalling the forms that the amœba is wont to assume; accordingly such cells have been called "amœbocytes." 4. Occasionally one sees still another cell, whose single large nucleus is oval or irregular in outline and lies in protoplasma like that of the "amœbocyte." These cells are larger than the other white blood-corpuscles, and contain here and there foreign bodies, such as pigment-granules and drops of fat in their protoplasma. They are called on account of their form "endotheloid cells." With further study of the preparation other forms are found, which may be looked upon as intermediate between "hæmatoblasts" and "amœbocytes," for in some cases the corpuscles have nuclei like "hæmatoblasts," whereas the protoplasm has increased in amount and sent out projections like the pseudopodia of an amœba; in others the nucleus is round instead of oval; in others still the nucleus seems to be in the act of falling into two parts.

These latter forms suggest the idea that a relation may exist between "amœbocytes" and "hæmatoblasts," but what the relation may be, whether the change is from "amœbocyte" to "hæmatoblast" or the opposite, whether the "eosinophilous cells" and "endotheloid cells" are in any way related to them and to one another, cannot be determined by the method just described. Two courses lie open to us in our attempt to answer these questions: 1, to examine the same blood at intervals after it has been taken from the frog; or, 2, to watch changes in fresh blood which has been protected from evaporation. To do the first we have simply to place a slide with a drop of blood upon it in a moist chamber,[1] and after certain intervals (five minutes, fifteen minutes, half an hour, two hours) to fix and color the blood as above. If we examine a preparation fixed at the end of two hours, the whole aspect is changed. We find representatives of the different forms, but not in the same proportion. The "endotheloid cells" have become more numerous and the other forms less so. The former have also become much larger, with broad hyaline borders. The granules of the protoplasma are coarser about the nucleus, but constantly smaller and less distinct towards the hyaline border. Between the protoplasma-granules are frequently pigment-crystals and bodies colored with eosin. These foreign bodies lie often in clear oval spaces next to the nucleus; otherwise these spaces are empty, or

[1] The moist chamber is easily constructed by covering the bottom of a flat-bottomed dish with wet filter-paper and placing a ground-edged cover upon the dish, whose edges should also be ground.

contain a small nucleus, a clump of yellow pigment, or a body closely resembling a small red blood-corpuscle. To control this experiment we may make use of another one,—that is, we may cover a fresh drop of blood with a cover-slip and seal it from the air.[1] Thus the blood coagulates slowly, and we may study directly the changes the forms undergo during coagulation. The granules of the "eosinophilous cells" may be seen to become larger, less distinct, and disappear. The "eosinophilous cell" has developed into the "amœbocyte." The "hæmatoblasts" assume the forms mentioned above, the nucleus and cell as a whole become round, and at length send out pseudopodia in every direction, so that it is impossible to distinguish them from "amœbocytes." The "amœbocytes," in their turn, at first stretch out their pseudopodia in a lively manner, then gradually attach themselves to the cover-slip, where they spread themselves over a large surface, and resemble the "endotheloid cells" with their broad borders of hyaline substance and the granulated protoplasma about the nucleus. If we now bring together the facts we have observed,—1, in instantly fixed blood; 2, in blood fixed after intervals; 3, in fresh blood,—we find that the first three kinds of white blood-corpuscles may at length become "endotheloid cells."

What is, then, the fate of the "endotheloid cells"? Are the bodies we have described as lying in their protoplasma and resembling incomplete blood-corpuscles to be considered as such? The endothelial cells which they resemble are, as is known, broad, flat cells that lie spread out on the inner surface of the blood-vessels similarly as the "endotheloid cells" flatten themselves out on the cover-slip. Their protoplasma is colored with nigrosin, and in the small capillaries, where one or two cells suffice to form the circumference of the capillary, has been observed to contain pigment and more or less developed red blood-corpuscles. Especially is this the case in the liver and spleen of the frog. If the spleen be teased out, and its cells fixed and colored in the manner mentioned above, not only do we find that the number of white blood-corpuscles, especially of the "endotheloid cells," is much larger in proportion to the red blood-corpuscles than it is in circulating blood, but other cells are present which possess the general characteristics of "endotheloid cells" and endothelial cells. They are richer in pigment, contain often several undeveloped red corpuscles, and cling together in groups. Gaule, in his Strassburg lecture, called these cells "ammenzellen," because in them he observed the development of the red blood-corpuscles. In the course of his observations of a series of frogs he noticed that the "ammenzel-

[1] The edges of the cover-slip must be thoroughly free from moisture, a bit of melted wax dropped upon every corner, and the wax then drawn along the edges of the cover-slip with a heated iron wire.

len" which lie in groups similar to the follicles of the animal spleen, between the arteries entering and the veins leaving the spleen on the periphery, undergo significant changes, normally, in the course of the winter, under the influence of pilocarpine, in a few hours. The result in both cases was the same. The "ammenzellen," at first rich in pigment, lose their pigment as the number of undeveloped corpuscles increases. At the same time the number of corpuscles in the circulating blood was counted, the result showing that as the pigment of the "ammenzellen" decreased the number of the circulating red corpuscles became greater, the quantity of undeveloped corpuscles increased, and that many of the circulating corpuscles were still bordered with granules of pigment. Another indication that blood-building elements are present in the "ammenzellen" was the iron reaction which the protoplasma gave with potassium ferrocyanide. From these observations it seems hardly to be doubted that red blood-corpuscles are developed in the "ammenzellen," and partially at least in the endothelial cells, and in the "endotheloid cells." The relation in which these three cells stand to the blood-vessels remains to be considered. The blood-vessels of the embryo have their origin, as the embryologists have taught us, in the mesoderm in chains of endothelial cells which contain clear spaces in their protoplasma that later communicate with one another to form a fine capillary, in whose walls the first red blood-corpuscles are formed. Returning to the spleen, we recall the fact that the "ammenzellen" groups lie between the capillaries of the arteries, with their endothelial cells on the one hand and the capillaries of the veins on the other hand, and that between the in-flowing and out-flowing vessels the regular blood-vessels with their lining cells fail. It is, then, not difficult to suppose that the "ammenzellen" and the "endotheloid cells," which are so numerous in the spleen, might be the stage upon which, as in the mesoderm of the embryo, a constant building of new blood-vessels and blood-corpuscles is taking place. The white blood-corpuscles of the frog may perhaps be looked upon as undeveloped "ammenzellen," though their origin and the functions peculiar to each form are not yet clear. It is significant that a seeming relation exists between the coagulation of the blood and the formation of white blood-corpuscles, for as the blood of the frog begins to coagulate the "hæmatoblasts" become especially numerous and group themselves characteristically; but to this point we shall refer again in connection with human blood, which is in many points similar to the blood of the frog.

The red blood-corpuscles of human blood contain, as is known, no nuclei. In our preparation they retain the disk form and color like the protoplasma of the red corpuscles of the frog with eosin. The white blood-corpuscles are represented by the two forms "eosinophilous cells" and "amœbocytes." The "hæmatoblasts,"

as such, are wanting in human blood, but since we have had our attention directed by Hayem to the fact that the "hæmatoblasts" play an important part in the coagulation of the frog's blood, it is possible to think that some element is present in mammalian blood which also acts as a factor in coagulation. The coagulation of the frog's blood begins with the grouping of the "hæmatoblasts" into a rosette form. The red corpuscles then arrange themselves radially about this point as a centre. Do we find an analogous process at the commencement of the coagulation of mammalian blood? The blood of mammals coagulates very rapidly, whereas that of the frog changes very slowly; hence, if we would study the blood of mammals before coagulation, we must prevent this process by means of some reagent. Such an experiment cannot be tried with a human being, but is easily made with a dog. The reagent usually employed is peptone, which is injected in solution into the jugular vein of the dog, the amount injected being 0.3 grain peptone for every kilogramme weight of the dog. The microscopical examination of blood in which coagulation has thus been prevented shows that there exist in the blood, aside from the other elements, tiny tablet-like granules which tend to cling together in clumps. These elements were described by Bizozerro, and called by him "blutplättchen." It thus seems probable that the "blutplättchen" have something to do with the coagulation of the blood. That they also exist in human blood is evident from their presence in our preparation as small, faintly-tinged bodies, which lie in groups of twos and threes together. They did not disappear from the blood we employed, because we did not give it time to coagulate before fixing it. Therein lies the advantage of this method in the examination of human blood. It gives us not only the possibility to distinguish the different elements of the blood, but through it, it has been possible to discover elements which, like the "hæmatoblasts," accompany the phenomenon of coagulation, and also to determine in part the relation that exists between the elements. It would not agree with the general plan of nature if every form did not play a different rôle in the organism, and after all that has been discovered it is not improbable that we shall one day be able, through watching the changes which the different elements undergo in the blood, to discover the disturbances caused by different ferments and organisms in the blood. Thus we think that the hope of clever physicians may one day be verified, that the analysis of a drop of blood may give a clue to the pathological changes in the body.—*Alice Leonard Gaule.*

PSYCHOLOGY.

Intelligence of Echinoderms.—The experiments of Professor Preyer upon starfish and ophiurids tend to prove that they are

not entirely devoid of intelligence. In one series of experiments a piece of tubing was placed over one of the rays of a brittle star, so as to enclose it from its base nearly to its apex. Different individuals adopted different modes of ridding themselves of the tube, and one failing, would try another. Sometimes they rubbed the tube off by friction on the ground; if this was useless, they would hold down the tube with the other rays while drawing the imprisoned ray through it, or they would push the tube off with the serrated edges of the two adjoining rays, or, as a last resource, would cast off the imprisoned arm.

SCIENTIFIC NEWS.

—The meeting of the German Naturalists' Association will be held this year at Wiesbaden, from the 18th to the 24th of September. Herr Dreyfuss, 44 Frankfurter-strasse, Wiesbaden, is the secretary of the local committee.

—The San Diego Natural History Society have had a present of a valuable lot of land, and propose soon to erect a building.

—Dr. R. W. Shufeldt criticises—and deservedly so—the veterinary service of the United States army. He would elevate it by placing it on much the same basis as the regular medical corps.

—John Sang, a British entomologist of note, died March 2, 1887, of valvular disease of the heart, at the age of fifty-nine. He was especially interested in the moths, and was a zoological artist of no mean powers.

—Dr. J. S. Poljakow, the Siberian explorer and conservator of the Zoological Museum of the University of St. Petersburg, died in that city April 17, 1887.

—The late Miss Lucretia Crocker, of the school board of Boston, was influential in the support of the Annisquam laboratory from the year of its foundation, as well as an earnest advocate of the teaching of the biological sciences in the public schools. It is now proposed to raise two "Lucretia Crocker scholarships" in connection with the new Marine Laboratory, to be occupied each season by two teachers of the Boston public schools. Twenty-five hundred dollars are necessary for the purpose.

—Princeton College is to have a new biological laboratory in the early future.

—The new building for the Zoological Museum at Berlin is completed, excepting the internal finishing. This, it is estimated, will take until April 1, 1888, and then the collections will be

transposed from their present location in the university building to their future home. On the 1st of May of this year Karl Möbius, formerly ordinary professor of zoology in Kiel, entered upon the duties of director of the Berlin Museum, being thus associated with Professor Dr. Edouard von Martens.

—Johns Hopkins University is to publish, as a memorial volume, the researches of the late Dr. Adam T. Bruce on the Embryology of Insects.

—Armauer Hansen calls attention to a peculiar kind of whale-fishing which has been practised for a long time in the neighborhood of Bergen, Norway. Each year the fishermen take a couple of specimens of the small whale known as *Balænoptera rostrata*. Their implements are the most primitive harpoons, and it would hardly seem as if the insignificant wound they cause could prove serious. In from twenty-four to thirty-six hours the whale shows signs of weakness, and then is readily despatched. It is now found that the region of the first wound is gangrened, and that the weakness was in reality the result of blood-poisoning. All the fishermen now smear their harpoons with the gangrened flesh, and put them away to dry for use another year. M. Gade has carried on some culture experiments with the microbes obtained from the whales for three successive years, and finds each time the same bacteria, principally the same micrococcus. It is a curious fact, as Hansen remarks, that this peculiar use of bacteria and septicæmia should have been known for hundreds of years.

—*Science* has canonized one of the living African explorers. On a map of the African continent given in the issue of May 27 appears "St. Stanley's Falls."

—Professor Prestwich, who for thirteen years has held the chair of geology at Oxford, England, has resigned.

—Dr. Eugene Korschelt, formerly privatdocent and assistant in the Zoological Museum at Freiburg, Bavaria, has taken a similar place at Berlin, while his former position is now occupied by Dr. E. Ziegler.

—The professorship of zoology in the Zoological Institute at Kiel will not be filled until Easter, 1888. Dr. Karl Brandt, privatdocent in Königsberg, has been appointed the interim director.

—Bronn's valuable "Klassen und Ordnungen des Thierreichs" drags its slow length along. The last parts published are Nos. 56 of the Reptiles, by C. K. Hoffmann; 16 and 17 of the Birds, by Hans Gadow; and 29 of the Mammals, by W. Leche.

—Dr. J. S. Kingsley, the junior editor of this magazine, has accepted the professorship of biology in Indiana University. After September 1 his address will be Bloomington, Indiana.

—Professor J. C. Branner, of Indiana University, has been appointed director of the geological survey of Arkansas, with headquarters at Little Rock. The university has granted him a two years' leave of absence.

—The trustees of the Elizabeth Thompson fund have awarded the following sums for the advancement of science: The Natural History Society of Montreal, two hundred dollars, for the investigation of underground temperatures under the direction of a committee of the society; Drs. T. Elsler and H. Geitel, of the Gymnasium of Wolfenbüttel, Germany, two hundred and ten dollars, for researches on the electrization of gases by glowing bodies; Professor E. D. Cope, of Philadelphia, five hundred dollars, for the employment of a preparateur in connection with his researches on fossil vertebrates; E. E. Prince, of St. Andrew's, Scotland, one hundred and twenty-five dollars, for studies on the morphology and development of the limbs of teleosts.

—Recent Deaths.—Dr. François P. L. Pollen, a Malagassy explorer, in Leiden, May 7, 1886, aged forty-four; Arthur Edward Knox, an ornithologist, in Dale Park, England, September 23, 1886; Dr. G. A. Fischer, African traveller and ornithologist, in Berlin, November 11, 1886; Dr. William Traill, conchologist, in St. Andrew's, Scotland, December, 1886; Dr. John M. Wheaton, professor of anatomy and ornithologist, in Columbus, Ohio, January 28, 1887; Robert Gray, ornithologist and vice-president of the Royal Society of Edinburgh, in that city, February 18, 1887; Dr. Nathaniel Lieberkuhn, professor of anatomy and student of invertebrates, at Marburg, April 14, 1887, in his sixty-fifth year.

—Death of Professor William Ashburner.—Professor Ashburner, mining engineer and geologist, died in San Francisco, April 20, at the age of fifty-six. He studied for his profession at the Lawrence Scientific School of Harvard University, and afterwards at the École des Mines, Paris. Returning to this country in 1854, he visited the mineral region of Lake Superior with the late Professor Rivot, for the purpose of investigating the geology and mineral veins of said country, and subsequently explored a part of the island of Newfoundland, and in 1860 went to California as one of the staff of the geological survey of which Professor J. D. Whitney was director. In pursuance of his profession he travelled extensively through the mining districts of the United States, British Columbia, Mexico, and portions of Asia. He was one of the State commissioners of the Yosemite Valley and the Mariposa Big-Tree Grove from 1864 till 1880, and professor of mining in the University of California, having been appointed in 1874. In 1880 he was made a regent of the university, and was named by the late James Lick as one of the trustees of the California School of Mechanical Arts (one of Mr. Lick's bequests), and was also selected by Mr. Stanford as one

of the trustees of the Leland Stanford, Jr., University. Professor Ashburner was identified with all the principal organizations whose object is the intellectual development of the Pacific coast, —the microscopical, geographical, and historical societies,—and for many years he was especially active as one of the trustees of the California Academy of Sciences. In the directions above indicated he was an eminently useful citizen, and his personal bearing and qualities greatly endeared him to many. The death of such a man is a public misfortune.—*R. E. C. S., Washington, D. C.*, May 10, 1887.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Philadelphia Academy of Natural Sciences.—February 1, 1887.—Dr. Leidy stated that the prevalent opinion that bed-bugs might be introduced by bats and swallows seemed improbable. The insect found on the swallow is related to, yet different from, that which infests houses. On a couple of little bats from Panama Bay he had found an allied, yet different, insect, described by Westwood as *Polyctenes fumarius*. Professor Heilprin stated that the rhizopods identified by Miss Fielde at Swatow as identical with Philadelphia forms were *Difflugia* (two species) and *Arcella vulgaris*. Dr. Koenig gave the analysis of two forms of asbestos from Franklin, N. J., which are distinguished from Sussexite by the absence of the green flame under the blow-pipe.

February 15.—Professor Ryder spoke of the distribution of papillæ giving rise to sensitive or tactile hairs. Such hairs are usually divided into groups, one of which occurs near the eyebrows, one below the eye, and a third lower down. The gray whale of the Pacific coast had more of these tactile hairs than any other cetacean the fœtus of which he had examined. He had recently observed in an embryo kitten an orderly linear arrangement of such hair-papillæ on the back, apparently corresponding to the color-stripes to be developed later. There were none on the limbs and sides. Dr. H. Allen said that he had noted that moles on the human face occupied the same positions as the sensitive hairs of the lower animals. Dr. Allen also stated that in the wombat the biceps muscle passes from the pelvis to the foot, receiving three other muscles before its insertion. He suggested a formula, consisting of the use of arrows in different positions, indicating origin, insertion, direction, etc., so as to save labor in recording details. Professor Heilprin put on record the stranding of a specimen of the Mediterranean Risso's grampus on the coast at Atlantic City. Professor Sharp suggested that the eyes of Onchidium were phosphorescent organs, similar to those he had before described as existing in

Pecten, especially since the snail has no locomotive powers which would enable it to escape from a foe seen by such eyes.

March 15.—A couple of copper coins, taken from the stomach of an ostrich which recently died in the Zoological Garden, were exhibited by Mr. E. A. Kelly. They formed part of a hard mass, which partly filled the gizzard. It was evident from the condition of the bolus that the muscular fibres of the stomach had not kept up such a spiral movement as is found in the crop of the pigeon or the stomach of the cow.

New York Academy of Sciences.—April 4, 1887.—Dr. Henry H. Rusby read some notes of recent travel on a journey from La Paz to Para through the Bolivian Andes and the Beni and Madeira Rivers.

April 18.—Dr. Alexis A. Julien read a paper on the transformations of iron disulphide, illustrating his points with specimens.

May 2.—Dr. Henry H. Rusby read a paper in continuation of that of April 4, on his travels across South America.

May 9.—Mr. George F. Kunz presented a paper on jade and jadite, and also read a description of the meteorite which fell March 27, 1886, near Cabin Creek, Johnson County, Ark.

Biological Society of Washington.—April 16, 1887.—Dr. William H. Dall presented some notes on a recent exploring trip to Florida. Dr. H. G. Beyer spoke of the action of caffeine upon the kidneys. Dr. C. H. Merriam referred to the depredations of the bobolink, or rice-bird, in the rice-fields of the South. Mr. F. A. Lucas presented some notes on the os prominens in birds.

Middlesex Institute.—May 11, 1887.—Mr. Sylvester Baxter read a paper descriptive of his second visit to Zuñi, describing one of the dances. Mr. Clarence Pullen made some remarks upon the various Pueblo Indians.

Essex Institute.—May 16, 1887.—Annual meeting. The following officers were elected: President, Henry Wheatland; Vice-Presidents, A. C. Goodell, Jr., F. W. Putnam, D. B. Hagar, and Robert S. Rantoul; Secretary, George M. Whipple; Treasurer, George D. Phippen; Librarian, William P. Upham. The annual reports which were read show a very substantial prosperity on the part of this institution. The ordinary income was five thousand two hundred and five dollars and eighteen cents, while two bequests amounted to fourteen thousand dollars. The total property in funds and real estate amount to (at original values) over seventy thousand dollars. The additions to the library for the year amounted to twenty thousand seven hundred and thirty-nine volumes and pamphlets, and the library is now estimated to contain fifty thousand volumes and over two hundred thousand parts of volumes and pamphlets. The Institute exchanges with over two hundred kindred societies, over half of which are foreign.

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NOTES ON THE ETHNOLOGY OF THE CONGO.

BY WALTER HOUGH.

THE Congo ranks among the mightiest rivers of the earth. Above the limit of the tide it floods over cataracts and miles of rapids bristling with rocks in its descent from the high African uplands. Indeed, it was a revelation to indomitable Stanley to find, after these obstacles were passed, navigable water flowing from the far interior.

Along its stretches of turbulent or placid water dwell many tribes of negroes. Cannibals and fierce savages are numerous, and, altogether, it is a dark and dangerous country drained by this river, from where its waters begin, on the common water-shed between it and the Nile, to its mouth on the west coast. The great wealth of ivory, dye-wood, rubber, palm-oil, and other products makes it profitable to establish many stations for traffic. The "Congo Free State," governed by Leopold, of Belgium, embraces a large territory gradually being explored and opened up to commerce.

Up to one year or so ago the National Museum possessed very few ethnological specimens from Africa, at which time Mr. W. P. Tisdel, agent of the United States to the Free States, brought home the first collection from that unknown region. Recently Lieutenant E. H. Taunt, U.S.N., visited the Upper Congo, and sent to the museum a large collection of barbaric weapons, ornaments, and various other objects made by the Congo tribes. These collections, with the one lately acquired from the Bureau of Arts in Paris, enable us to speak with some

degree of confidence about the customs and arts of these Africans. The collections are, as one would reason, rich in weapons and poor in clothing, coming from the region of perpetual feud and almost utter nakedness. It is interesting to remark that nearly all the African tribes know the art of smelting iron, and make a fine quality of metal by the rudest sort of apparatus; in fact, they are in the Iron Age. It is unknown how these savages of low grade became acquainted with the iron-smelting process, —an art which indicates a great step in civilization. Though a matter of conjecture, it is highly probable that from that ancient and mysterious mother of arts and sciences, Egypt, came this knowledge of the use and manufacture of iron throughout the entire "Dark Continent."

Africa is very rich in iron. Travellers have noted great beds of highly-oxidized ore of a kind particularly fitted for these simple operations. The usual method of smelting iron is to pile layers of ore and charred wood in a small mud furnace. A continuous current of air is blown in by two bellows working alternately, or, among the Bongo, there are simply four or five draught-holes at the bottom of the furnace. When the ore has been smelted the furnace is allowed to cool, and the cake of ashes is washed, the lumps of iron collected, reheated, and pounded into a coherent mass with a stone hammer on a stone anvil. The iron thus made is very tenacious and remarkably rust-proof. It is preferred by the natives to steel or foreign iron, because if an assagai-head is bent into an interrogation-point the warrior calmly beats it into shape with a stone. The iron also holds a good edge; in fact, a sharp assagai-head is the razor of the uncivilized barber. The weapons, which are hammered out with a stone, are, despite the fact, finely finished, and are as creditable specimens of smith-work as can be found. The common idea that conventionality and repetition in art argues a low degree of civilization is met by the fact that the aboriginal workman cannot make two things alike. He does not work by pattern; he follows, for instance, the shape of his iron or the suggestion of a chance blow. This is the reason of the so-called "originality" of all peoples not practising division of labor or using machines. Among the forty-five specimens of assagais every one is different, although they can be separated into several groups by general likenesses.

Travellers say that there is rivalry among smiths to produce different and bizarre forms, and, as a result of this, many weapons are made which are of no use, being merely *chef d'œuvres* of the blacksmith. The typical assagai and javelin has a leaf-shaped blade, which is double curved; that is, a horizontal section of the blade would show a curve like a thin S, or like Hogarth's line of beauty. This feature has no special use, as the assagai does not whirl in its flight. At the base of the blade is a socket into which sets the long, slender shaft, usually wound with brass, copper, or iron tape. At the bottom is an iron spud, though not found on those for hurling. It is said that in the act of throwing the weapon the negro gives it a vibratory motion, so that it passes through the air with a whistling sound. Arrows are made with uncomfortable-looking barbed points. Knives are merely assagai-heads fitted into handles. The shields are among the finest specimens of basket-work in the world. They are models of lightness and strength besides. Professor Mason describes the mode of construction, and compares it with the similar work done by the Clallam Indians and the Japanese. He calls it the "fish-trap" style of basketry, and states that "the oblong oval shields of bamboo made by the Bateke negroes of the Lower Congo imitate this structure exactly. The frame of the shield is an oblong hoop on which are stretched splints of rattan running longitudinally on one side and transversely on the other, crossing at right angles except at the plano-convex space at the ends."[1]

Just mentioning the short swords and bill-knives, some of them highly decorated with nut-shell fringe and leopard-skin, we note the executioner's sword. Its blade is short, broad, and heavy, and it is sharp on both sides. It is really in bad taste to describe an execution, but life there is so cheap and the Congo-African way of relieving a man of his head so unique that it will bear description. In order to give an *éclat* suitable to African taste, and to render the feat of decapitating with the weapon possible, the victim is secured to a seat and a strong sapling bent down and fastened by means of cords and a collar around his neck; then, while his neck is taut the high executioner delivers the blow, and the severed head is thrown into the air like a bomb.

[1] Aboriginal Basket-Work, Smithsonian Rept., 1884, ii. p. 298.

The Nyam-Nyam and several Congo tribes have a very peculiar knife-boomerang. It is a weapon sharp on all edges of its blades,—it might be called a collection of knife-blades. It is kept concealed in the shield, and is thrown with a whirling motion, and its wide path and the accuracy and force with which it is thrown make it a dangerous weapon.

At the Stanley Falls Station, now held by the Arabs, a strange kind of money is current, called, from its shape, "spade money," being pieces of iron used as a medium of exchange. The relative rank of money in Africa makes iron equal to copper, and copper to silver. Cloth is a very common barter medium, and its use is mostly not for dress, but the custom is to wrap the dead in many folds of cotton goods. Cotton grows abundantly, and a coarse, narrow cloth is made.

A stuff exactly similar to Mocha coffee-sacking is woven, and highly valued. It is grass-cloth, as it is commonly called; but sometimes it is made of the tough outer bark of some kind of shrub, and it is woven by men. The staple food of the Congo region is manioc, or cassava roots, which are pounded in mortars with large pestles of ivory. Peanuts are also cultivated. Several spoons in the Taunt collection are said to have been used in the cannibal feasts of the Arrhuimi River tribes. Pipes are made of horns, and the bowl is placed on one side. The horn is filled with water, and the smoke is inhaled by suction at the open end. Travellers speak of the extremely intoxicating effect of the tobacco and hemp mixture, which is brought out more powerfully by being drawn through water.

The customs and beliefs of these Africans with regard to the spirit-world are very crude. A belief in evil spirits, witches, good and bad luck comprises nearly all of the religious elements of the negro-life. The "doctor" is the interpreter of religion, and the fetish is a safeguard against all harm. There are many Mohammedans, who practise a debased form of that worship. It seems that no form of religion can withstand the brutalizing effect of the African nature and the childishness of his temperament.

What will be the future of this section of Africa, its relation to the world of commerce, and the extent to which it will be affected by modern civilization are difficult problems. While it is capable of supporting a large population, the climate is malarious and utterly unfit for Europeans. The African seems to have

gained an immunity or idiosyncrasy to miasmatic influences by generations of adaptation. He has made little progress in civilization. This is due to the lack of inherent capability of the negro type more than any other cause. The lack of harbors on the coasts of Africa has always and will in the future militate against the settlement and growth by advanced races. It looks now as if this continent, vast in wealth and area, is becoming overrun by the fierce disciples of Islam, the most undesirable settlers possible, and in whose hands it will be lost in an irreclaimable darkness. Another great bane to the Congo and all Africa is the accursed slave-trade. For over three thousand years she has bartered her children to be slaves over the whole earth. Livingstone, Schweinfurth, Stanley, and many other distinguished explorers have seen, with anguish, this comprehensive atrocity in all its phases, and have tried to perfect plans for putting it down. The Congo Free State, through Henry Stanley, has done much to suppress this evil. That recent brilliant master-stroke of enlisting Tippo Tib, the prince of slave-traders, against the slave-trade cannot receive too much praise, and it is to be hoped that, as another laurel in Stanley's crown, he may successfully rescue Emin Bey, the soldier-scientist, from his perilous position in the heart of Africa, and restore him, with his large collections, to the civilized world.

NOTES ON CLASSIFICATION AND NOMENCLATURE FOR THE AMERICAN COMMITTEE OF THE INTERNATIONAL GEOLOGICAL CONGRESS, MARCH, 1887.

BY N. H. WINCHELL.

THE PALÆOZOIC.—In the light of recent work done in the classic region of American geology, Eastern New York, by Messrs. Ford and Walcott, reviving some of the old questions that separated the geologists of forty years ago into widely variant schools, it becomes appropriate for this committee to earnestly and justly weigh the facts so far as they bear on the choice of names for recommendation to the next congress.

It will have to be admitted that the scheme of stratigraphy

which was erected by Mr. Emmons, including formations that extended eastward into Massachusetts and Vermont, and westward to the Hudson River, covering a series of strata from the gabbros of the Adirondacks to the top of the Lorraine shales, has been overthrown by the researches of Dana and his colleagues,—in other words, that the "Taconic System," as constructed by Dr. Emmons, cannot be maintained.

On the other hand, the Taconic rocks, in which Emmons found primordial fossils, and to which he extended the name which he applied to his system, have been found to have a wide extension and a great thickness, as well as a characteristic fauna. The initial point of divergence between him and his colleagues on the New York survey was as to the existence of such pre-Potsdam strata. From this initial point he built up a system without warrant. He laid a true foundation, but his superstructure was not well built. In consequence of a poor superstructure, the tendency has been strong to sweep away also his foundation, denying to both of them the right to existence in geological nomenclature.

The question that comes before this committee is to determine by what designation the strata shall be known that contain the foundation-rocks of the "Taconic System" of Emmons,—those that really are stratigraphically pre-Potsdam.

Recent palæontological researches and work in the field show that the pre-Potsdam fauna pervades a belt of rocks that extends from Northern Vermont southward, by way of Georgia, Vermont, Bald Mountain, New York, Schodack Landing, to Stockport, Columbia County, east of the Hudson River, comprising a thickness of strata amounting to about four thousand feet. It is also reasonable to suppose that it constitutes the basal portion of the range of the Taconic Mountains, and perhaps a large part of the range in some places. It is therefore not inappropriate to consider the claim of Dr. Emmons to give name to this belt.

(*a*) Taconic *versus* Primordial.

The term *primordial*, adopted by Barrande for the first fauna, is more comprehensive than the fauna that was discovered by Emmons in these Taconic strata. But Barrande distinctly acknowledges that Dr. Emmons antedated him in the discovery and advocacy of a fossil horizon belonging in the primordial

zone. There can be no question, when the author of the term primordial makes such an admission, that, other things being equal, the term first used should be perpetuated. But it may be stated that other things were not equal. They were not equal in the thoroughness with which the fauna was investigated, nor the correctness with which the stratigraphic relationships were stated, nor in the limitations which were placed on its extent. They were not equal in the comprehensive, uninterrupted progress with which the respective investigations were carried on on different sides of the Atlantic, nor the completeness and costliness of publication. But it may be doubted whether any of these differences, or all of them, would warrant the unqualified adoption of the European term, to the exclusion of the American, against the right of priority for the American geologist. Emmons did, it seems to me, all that was required, or that is now required, to establish his claim to the discovery of a new formation. He defined it geographically, stratigraphically, and palæontologically. No one else in America has applied any new name to it. It came in conflict, it is true, with another American designation, but no one now will urge the correctness of that opposing term. As between *Taconic* and *primordial*, both authors may be recognized and honored by confining the term Taconic to the identical horizon, or sub-fauna, in which it was described by Dr. Emmons, allowing the term primordial to embrace, as intended by Barrande, all the sub-faunas of the first fauna.

The first (oldest) sub-fauna is characterized by the genus *Paradoxides.*

The second sub-fauna is characterized by *Olenellus.*

The third sub-fauna is characterized by *Dicelocephalus.*

(*b*) Taconic *versus* Cambrian.

But we cannot overlook the fact that in Europe, and also in America, the term Cambrian is very generally applied to this fauna and the formation in which it is embraced, to the exclusion of both *Taconic* and *primordial.* This is a very singular circumstance. The reaction which set in to do justice to Sedgwick had such momentum that it swept over its own bounds and became itself an agent of injustice.

If the question of the relative dates at which the terms Taconic

and Cambrian were first used be brought to bear on this investigation, the facts will be found to be about as follows:

Murchison says the term Cambrian was first used in print in 1836, but Sedgwick says he had been at work on the formation since 1831, his first description being made and published in brief in the *Proceedings of the British Association for the Advancement of Science* in 1832. In 1855 he also says he had made no material changes in the Cambrian since 1832, except some minor transpositions of stratigraphy. All this time the lower portion of these rocks was considered non-fossiliferous, Sedgwick not being willing even to admit the verity of fossils belonging to the primordial fauna in any of the rocks of his series. It is a singular fact that, although Mr. E. Davis discovered fossils in the rocks of the Cambrian in 1845, and had re-examined the locality with Mr. Sedgwick in 1846, and announcement of the discovery was made the same year, yet the English geologists did not know, or would not admit, that the primordial fauna of Barrande was contained in the rocks of the Cambrian till 1851, when Barrande visited the Woodwardian Museum, and examined also the collections of the survey; and even then they would not admit it till they had sent some of their own officers over the ground which they had considered finally examined, and these had returned with a convincing collection of primordial fossils.

Barrande's *notice preliminaire* of the primordial fauna of Bohemia was issued in 1846, two or three years after the discovery of primordial fossils in the Taconic, and five years before the discovery of primordial fossils in the Cambrian.

It appears, therefore, that as a formation of rocks, without reference to geological age or relation to other formations, the Cambrian was studied by Sedgwick four years before Emmons began official work on the New York survey; that the term Cambrian was used as a designation for the formation which Sedgwick was engaged on in 1835; and that Emmons used the term Taconic officially first in his volume dated 1842. Emmons was, however, at work incidentally on the Taconic rocks much earlier. Professor Dewey mentions a mineral found by him and analyzed in 1820 (*Am. Jour.*, (i.) ii. 249). Professor Dewey uses the *Taconic range* as a geological entity, and the rocks of the range as a starting-point, in his "Geological Section from Williamstown to the City of Troy," published in 1820. The term

was first used by him in a geological article dated January 27, 1819. Lee, Hitchcock, Emmons, Dewey, Barnes, Briggs, and Eaton, between 1819 and 1842, frequently use the term in their geological papers. They considered the rocks extending from the western towns of Vermont and Massachusetts westward to the Hudson River as constituting a group different from those farther east, and set off by geological distinctions so markedly that they could not be confounded. Sometimes these rocks were referred to as the *rocks of the Taconic range*, sometimes as *transition rocks*, and sometimes as the *metamorphic group*. But that they were a single group, *en masse*, was not questioned, either by the friends or the opponents of the Taconic system, as late as 1844, Eaton having gone so far as to place them below the strata of the New York system.

Used, then, as a datum of geological reckoning, "the rocks of the Taconic range" date from 1819, but it was not till 1842 that Dr. Emmons erected these into a geological group and formally announced the "Taconic System."

The foregoing facts may be tabulated as below :

	Used as a Faunal Designation.	Used in Geological Literature.	Used as Name of a Zone or System.
Primordial	1846	1846	1846
Cambrian	1853	1836	1836
Taconic	1844	1819	1842

In thus calling attention to the use of the term Taconic in geological literature as early as 1819, the objection will naturally arise in the minds of some of the committee that the term was used wholly as a geographic and not as a geological one, and hence that it has no claim in geological nomenclature. While there is some force in this objection, yet, if the nature of the papers written by the earlier geologists be examined into, it will be seen at once that the term was used both in a geographic and in a geological sense. Professor Dewey, in 1820, giving his *geological section from the Taconic range to Troy, N. Y.*, says distinctly that the same rock-formation which constitutes the range at Williamstown extends to the Hoosac Valley, and gives place to a chlorite slate, which, since it is also found in the Taconic range, "ought to be considered as belonging to the range, and as the rock into which the talcose slate passes." From here he continues the section through graywacke rising into the hills at

Petersburg, constituting the mountains of Grafton, and extending as a general rock to Troy, where it is succeeded by a stratum of argillaceous slate, which extends to the banks of the Hudson.

In a general way this group of rocks is referred to as the "metamorphic series," or "transition series," as well as *the rocks of the Taconic range*, by other geologists up to 1842. As a geological designation it had no more force than the terms used by Sedgwick when he referred to the rocks of the Malvern Hills, or of the Longmynd Hills, or the term that was at first used to express the formation of the Helderberg Mountains in New York. In those early days of the century geologists made their designations refer to mineralogical and lithological characters rather than to systematic stratigraphy. Geographic designations had not yet been introduced with the authoritative endorsement of Murchison. There was but imperfect knowledge of systematic stratigraphy; but geographic terms were converted, by an easy scale of varying terminology, into geological terms. The "rocks of the Longmynd" became thus the *Longmynd rocks*. The rocks of the Helderberg Mountains became thus the upper and lower Helderberg rocks; and Mr. Emmons sagaciously chose to erect the rocks of the Taconic range into the Taconic system.

It is customary to date the "Taconic System" from the year 1842, when it was officially announced by Dr. Emmons, and it is just to give the term Taconic its full right as a distinct term in geological nomenclature only after that date, parallel with a similar use of the term Cambrian; but it cannot be questioned that the term Taconic was a semi-geologic term for at least twenty years before.

It may next be asked, What was the intent of the authors of these names? In the absence of perfectly conclusive evidence as to the historic priority of one, in all respects, over the others, when the facts seem to have a divided and variant significance, this may be the only way in which a just conclusion can be reached. It is not necessary to enter upon the citation of facts or quotation of authorities. The following conclusion, so far as Mr. Barrande is concerned, will hardly be questioned. *He worked to elaborate a fauna, and when that was established he denominated the strata the primordial zone.* In doing this he went no farther back than 1846.

In respect to Mr. Sedgwick, he worked on a series of rocks which he thought pertained to a single system, and illustrated it by fossils. These proved to be, for the most part, species of the Bala group, consisting of the second fauna. What few primordial fossils he found he placed within the same fauna. He claimed this fauna and this system of rocks as his Cambrian. This was named in 1836. It was no error of his that subsequently his term was crowded downward and removed from the rocks of the second fauna, and made to cover only a fauna of which he knew nothing. In other words, *the author of the Cambrian intended to include in his system only the rocks containing the second fauna.* Still, his stratigraphic scheme embraced lower beds.

In respect to the intention of Mr. Emmons, he worked on a series of rocks which he claimed was lower than the New York system. He announced a fauna which he intended to illustrate his system. The strata which he included in his system have been proved to contain his alleged fossils, and they pertain to a horizon below the New York system. All rocks known by him to contain fossils of the second fauna occurring within the general Taconic area were exempted by him from the Taconic system. *His main intention, both stratigraphic and palæontologic, therefore, was to include the rocks of the primordial fauna in his system.*

On the question of priority, therefore, the inquiry is reduced to the conflict between Cambrian and Taconic, with the Taconic having two counts to the Cambrian one.

On the question of the relative validity of those counts, the Taconic has that of correctness of palæontological identification and that of use in geological literature, which are very strong, while the Cambrian has that of formal announcement as a system.

On the question of the intention and claim of the author, the Taconic was correct in stratigraphy and palæontology when applied to the *first fauna*, and incorrect when applied by its adversaries to the second fauna. The Cambrian was correct in palæontology, and was not corrected by its author in stratigraphy when applied to the *second fauna*, and is incorrect in both respects when applied by its friends to the first fauna.

If the errors be eliminated, on each side, the first fauna should

be assigned to the Taconic and the second to the Cambrian. This will, of course, require the restriction of the term Silurian to the rocks of the *third fauna*, or to as much of it as was at first covered by that term, as argued by Hunt, Marcou, Rogers, Dawson, Jukes, and others.

The weight of authority and of usage has been in favor of covering the rocks in dispute between Murchison and Sedgwick, so far as they both claim strata holding the second fauna, by the Murchisonian term. Of the merits of this controversy I have nothing to say. It may fairly be left to the English geologists to decide. It would be an easy adjustment of all the conflicting claims, however, to assign, *pro honoris causa*, the first fauna to Emmons, the second to Sedgwick, and the third to Murchison.

THE ARCHÆAN.—It is my individual opinion that no subdivisions of the Archæan can be made, with an approach to probable acceptance and long-continued usefulness, at the present time. It would be judicious to introduce some indeterminate, non-descriptive terms, such as *Archæan No. 1* and *Archæan No. 2*, or *Archæan No. 3*, which could be interpreted by each locality, and applied by the geologists of each country, according to individual preference. In the Northwest, including Wisconsin, Minnesota, and Manitoba, much is now being done on the systematic study in the field of these rocks, and, without saying that the recognized, usual subdivision into Huronian and Laurentian is not valid in very large areas, it is true that, as a general scheme, this simple nomenclature is not applicable. I speak of these rocks as "Archæan" because of the general use of that designation. The terms *azoic* and *eozoic* may have prior rights, and, perhaps, ought to be used instead.

HISTORY OF GARDEN VEGETABLES.

BY E. LEWIS STURTEVANT, A.M., M.D.[1]

(Continued from page 532.)

Caterpillars. *Scorpiurus* sp.

A STRANGE taste causes various species of Scorpiurus to be included among our garden vegetables, the caterpillar-like forms of the seed-pods being used as salad-garnishing by those fond of practical jokes. As a vegetable their flavor is very indifferent. The species enumerated by Vilmorin are *Scorpiurus vermiculatus* L., the common caterpillar; *S. muricatus* L., the prickly caterpillar; *S. sulcatus* L., the furrowed caterpillar; and *S. subvillosus* L., the hairy caterpillar. This latter species is figured by Dodonæus in 1616, and is said even then to be sometimes grown in gardens. They are all native to Southern Europe.

Catnip. *Nepeta cataria* L.

It is hardly worth while to notice this plant of insignificant use, yet still holding a place in the herb-garden, and, in France, grown for use of the leaves as a condiment.[2] In 1726, Townsend[3] says it is used by some in England to give a high relish in sauces. It is a native of Europe, and is now common throughout Eastern America. It is mentioned among the plants of Virginia by Gronovius,[4] as collected by Clayton preceding 1739.

Catnip (called also *Nepp*) has for name, in France, *menthe de chat, herbe aux chats;* in Germany, *gemeines Katzenmunze,*[5] *Nepte;* in Holland, *kattekruid, nept;* in Denmark, *katteurt, sisembrandt;* in Sweden, *kattmynta;* in Italy, *gattaria;* in Spain, *gatera;* in Portugal, *neveda dos gatos;* in Russia, *koschitza melta.*[6]

Cauliflower. *Brassica oleracea botrytis cauliflora* DeC.

I am unable to recognize the cauliflower in any of the cabbage tribe described by the ancient authors, although the perfected condition of our present vegetable would lead us to assign to it a great antiquity. Its not being mentioned by Ruellius (1536),

[1] Director of the New York Agricultural Experiment Station, Geneva.

[2] Vilmorin, Les Pl. Pot., 1883, 354.

[3] Townsend, Seedsman, 1726, 36.

[4] Gronovius, Fl. Virg., 1762, 89.

[5] Vilmorin, l. c.

[6] Mill. Dict., 1807.

Fuchsius (1542), Roszlin (1550), Tragus (1552), Matthiolus (1558), and others would lead us to infer that it had not yet entered into general European culture. According to Bauhin it is mentioned in the French edition of Dodonæus, 1553 or 1559. The race of cauliflowers owe their peculiarity to a suppression of the floral organs and an abnormal development of the pedicels of the inflorescence. This peculiarity finds recognition in the majority of the names applied in the various languages, as will be observed in the following synonymy:

Brassica florida. Adv., 1570, 91; Ger., 1597, 246, fig.
B. florida botrytis. Lob., Obs., 1576, 123, *cum ic.;* Lob., ic., 1591, i. 245.
B. cauliflora. Cam., Epit., 1586, 252, *cum ic.;* Matth., 1598, 367, *cum ic.;* Dod., 1616, 624, *cum ic.;* Bauh., Pin., 1623, iii.; Bodæus a Stapel, 1644, 776, *cum ic.*
B. pompeiana, B. cypria. Lyte's Dod., 1586, 636.
B. pompeiana aut cypria, B. florida dodo. Lugd., 1587, 522, *cum ic.*
B. cypria sive pompeiana, vulgo caulifiori. Cam., Hort., 1588, 29.
B. cauliflora, pompeiana plinio. Bauh., Phytopin., 1596, 177.
Bradica florida. Cast., Dur., 1617, ap. *cum ic.*
B. multiflora. J. Bauh., 1651, ii. 829, *cum ic.;* Chabr., 1677, 269, *cum ic.*

The vernacular names earliest recorded are mostly founded upon the bloom, and may be translated flowering-cabbage. In the English name used by Lyte in 1586 we have a source of origin indicated, as *Cypress coleworts.* Dalechampius likewise, in 1587, gives one French name as *Chou de Cypre.* Pierres Pompes, a French author of 1694, is quoted by Phillips as saying about the cauliflower, "It comes to us in Paris, by way of Marseilles, from the isle of Cyprus, which is the only place I know of where it seeds." Strange, indeed, it is to find, at a date as remote as 1565, the cauliflower to be reported as abounding at Hayti, in the New World,[1] at a date preceding nearly all our recorded mentionings. It was, however, a well-known and carefully-cultivated plant in France in 1612, if we may trust "Le Jardinier Solitaire." Rauwolf,[2] who travelled through the Orient in 1573–75, found the Caulifiore at Aleppo. In England it is figured by Gerarde in 1597, and must have been known to Lyte in 1586,

[1] Benzoni, Hist. of the New World, Hak. Soc. Ed., 91.
[2] Gronovius, Fl. Orient., 1755, 81.

as he gives an English name,—*flowrie cole*, or *Cypress coleworts*; but, according to Parkinson, it was rare in 1629. In 1683, Worlidge praises them greatly. According to Heuze,[1] three varieties of cauliflowers were described by Ibn-al-awan for the Nabathean agriculture in Spain in the twelfth century.

In 1778, Mawe[2] mentions for varieties only the early and the late, scarcely differing. In 1806, in America, McMahon[3] knew the same only, and but two varieties are named by Bridgeman[4] in 1832. In France, in 1824,[5] three varieties—*le dur*, *le demi-dur*, and *le tendre*—are named, and the same in 1829.[6] In 1883, Vilmorin[7] describes sixteen sorts; and Burr[8] describes ten sorts for America in 1863.

The varieties of the cauliflower are essentially of one type, although some are more highly improved than others; and there are differences in size, height, and season, one kind even being purplish in the head. The distinctions are, however, not highly constant, and variations found in the growing serve to bridge whatever chasms may appear; and hence we may conclude that the varieties are but due to seminal variation carefully selected.

The names given to the *cauliflower* in various countries are: in France, *Choux-fleurs;* in Germany, *Blumenkohl*, *Carfofil;* in Flanders and Holland, *bloemkool;* in Denmark, *blomkaal;* in Italy, *cavol-fiore;* in Spain, *Coliflor;* in Portugal, *Couve flor;*[9] at Constantinople, *karnabiti;*[10] in India, *phool kobee.*[11]

CELERIAC.[12] *Apium graveolens* L., *var. rapaceum* DeC.

This vegetable is described by Gray[13] as a state of the common celery in which the root is enlarged and eatable. It presents but

[1] Heuze, Les Pl. Alimen., i. p. iv.
[2] Mawe, Gard., 1778.
[3] McMahon, Am. Gard. Kal., 1806.
[4] Bridgeman, Young. Gard. Assist., 1832.
[5] L'Hort. Fran., 1824.
[6] Noisette, Man., 1829.
[7] Vilmorin, Les Pl. Pot., 1883.
[8] Burr, Field and Gard. Veg., 1863.
[9] Vilmorin, Les Pl. Pot., 1883, 144.
[10] Forskal, Fl. Ægypt.-Arab., xxix.
[11] Speede, Ind. Handb. of Gard., 1842, 116.
[12] Since writing the above I have come into possession of Porta's Villæ, lib. xii., 1592, and on page 686 he speaks of the *Apium capitatum* as found in the gardens of St. Agatha, Theano, and elsewhere in Apulia, taken from nature, and as unnoticed and unnamed by the ancients. He describes the bulb as being of the size of the human head, and of a sweet, odorous, and grateful taste. He also implies the beginnings of an unsuccessful culture elsewhere.
[13] Gray, Field, Forest, and Gard. Bot., 165.

few varieties,—one with a rough root, one with a globular, smooth root, one with variegated leaves, and a fourth which is very much dwarfed. Other varieties are named, but the differences are very unessential. In French works on gardening of 1826 and 1829[1] the white and the red, the latter described as with the bulb veined with red or violet, are mentioned, together with a sub-variety with a round root.

In 1536, Ruellius,[2] in treating of the ache or uncultivated *smallage*, as would appear from the context, says the root is eaten, both raw and cooked. Rauwolf,[3] who travelled in the East (1573–75), speaks of *Eppich*, whose roots are eaten as delicacies, with salt and pepper, at Tripoli and Aleppo; and J. Bauhin,[4] who died in 1613, mentions a *Selinum tuberosum, sive Buselini speciem*, as named by Honor. Bellus, which seems to be the first mention of the true celeriac that I find, as the earlier references quoted may possibly refer to the root of the ordinary sort; although I think not, for at this date the true celery had scarcely been sufficiently developed. In 1729, Switzer[5] describes the plant in a book devoted to this and other novelties, but adds that he had never seen it; and this indicates it was little known in England at this date, for he adds that the gentleman, who had long been an importer of curious seeds, furnished him with a supply from Alexandria. It is again named in England in 1752;[6] 1765,[7] and by succeeding writers, but is little known even at the present time. It is described by McMahon[8] for American gardens in 1806. In France and Germany it is commonly employed as a vegetable and as a salad. It is even cultivated in the Mauritius.[9]

Celeriac, or *turnip-rooted celery*, is called, in France, *céleri-rave;* in Germany, *Knoll-Sellerie;* in Flanders and Holland, *Knoll-Selderii;* in Denmark, *Knold-Selleri;* in Italy, *sedano-rapa;* in Spain, *apio-nabo, apio-rabano.*[10]

[1] Petit, Dict., 1826; Noisette, Man., 1829.
[2] Ruellius, De Nat. Stirp., 1536, 708.
[3] Gronovius, Orient., 1755, 35.
[4] J. Bauhin, Hist., 1651, iii. pt. 2, 101.
[5] Switzer, Method of Raising . . . Celeriac, etc., 1729, 9.
[6] Mill. Dict., 1752; ex. Mill. Dict., 1807.
[7] Stevenson, Gard. Kal., 1765, 30.
[8] McMahon, Am. Gard. Kal., 1806.
[9] Bojer, Hort. Maur., 1837, 158.
[10] Vilmorin, Les Pl. Pot., 76.

Celery. *Apium graveolens* L.

I have previously given the history of celery in the American Naturalist for July, 1886. I can add only a few references to those therein given. "Le Jardinier Solitaire" (1612) gives directions for the cultivation of "Celery" in France, and Mentzel[1] gives the word "Sellerrey" in Belgium, and "Sellerey oder Aeppich" in Germany, with "Tabernæmontanus" as a reference. Now, one edition of "Tabernæmontanus" was published in 1588, and if this reference be correct we are able to carry the use of the word *celery* into the sixteenth century. Albertus Magnus,[2] who lived in the thirteenth century, evidently speaks of the wild plant when he calls it aquatic, but describes characters which apply to the smallage by adding that it has a concave foot-stalk, recumbent and white.

In China, at the present time, the name of celery is *Ch'in ts'ai*.[3]

Chard. *Beta vulgaris* L.

The chard was the Beta of the ancients and of the middle ages. The red chard was noticed by Aristotle[4] about 350 B.C. Theophrastus[5] knew two kinds,—the white, called Sicula, and the black (or dark green), the most esteemed. Dioscorides[6] also records two kinds. Eudemus, quoted by Athenæus[7] (the second century), names four,—the sessile, the white, the common, and the dark, or swarthy. Among the Romans the chard finds frequent mention, as by Columella,[8] Pliny,[9] Palladius,[10] Apicius,[11] etc. In China it was noticed in writings of the seventh or eighth century, the fourteenth, sixteenth, and seventeenth centuries;[12] in Europe, by all the ancient herbalists.

The chard has no Sanscrit name. The ancient Greeks called

[1] Mentzel, Index Nominum, 1682, 30.
[2] Albertus Magnus, De Veg., Jessen ed., 1867, 480.
[3] Gard. Chron., July 10, 1886, 41.
[4] Aristoteles, Scaliger's ed., 1566, 69.
[5] Theophrastus, Bodæus a Stapel ed., 1644, 778.
[6] Matthiolus, Comment., 1558, 248.
[7] Quoted from Turre, Dryadum, etc., 1685, 442.
[8] Columella, lib. x. c. 251; lib. xi. c. 3, etc.
[9] Pliny, lib. xix. c. 40.
[10] Palladius, lib. iii. c. 24; iv. 9; v. 3; vi. 4; viii. 2.
[11] Apicius, lib. iii. c. 2, ii.
[12] Bretschneider, Bot. Sin., 53, 59, 79, 83.

the species *teutlion;* the Romans, *beta;* the Arabs, *selg;* the Nabathean, *silq.*[1] Albertus Magnus,[2] in the thirteenth century, uses the word *acelga*,—the present name in Portugal and Spain. The modern names are: French, *poirée;* German, *Beisskohl, Beet, Mangold;* Flanders and Holland, *snij beet;* Denmark, *blad bede;* Italy, *bieta befitola;* Spain, *bleda* and *acelga;*[3] in China, *tien ts'ai.*[4]

The wild form—*Beta maritima* L.—is found in the Canary Isles, the whole of the Mediterranean region as far as the Caspian, Persia, and Babylon; perhaps even in Western India,[5] as also about the sea-coasts of Britain.[6] It has been sparingly introduced into kitchen-gardens for use as a chard.[7]

The red, white, and yellow forms are named from quite early times; the red by Aristotle, the white and dark green by Theophrastus and Dioscorides. In 1596, Bauhin[8] names the dark, the red, the white, the yellow, the beet with a broad stalk, and the sea-beet. These forms, while the types can be yet recognized, yet have changed their appearance in our cultivated plants, a greater compactness and development being noted as arising from the selection and cultivation which has been so generally accorded in recent times.

Vilmorin describes for varieties the white, the Swiss, the silver, the curled Swiss, and the Chilian chards. To this we may add less improved forms, such as the sea-beet.

Sea-Beet.

Beta sylvestris spontanea marina. Lob., Obs., 1576, 125.
B. sylvestris maritima. Bauh., Phytopin., 1596, 191.
Sea-Beet. Ray, Hist., 1686, i. 204.

The leaves form an excellent chard, and in Ireland are collected from the wild plant and used for food,[9] and in England the plant is sometimes cultivated in gardens.[10] This form has been ennobled by careful culture, continued until a mangold was obtained.[11]

[1] De Candolle, Orig. Des Pl. Cult., 47.
[2] Albertus Magnus, De Veg., Jessen ed., 1867, 8.
[3] Vilmorin, Les Pl. Pot., 1883, 420.
[4] Gard. Chron., July 10, 1886, 41.
[5] De Candolle, l. c., 46.
[6] Lindley, Morton's Cyc. of Ag., i. 234.
[7] Targioni Tozetti, Hort. Trans., 1854, 147.
[8] Bauhin, Phytopin., 1596, 190.
[9] Johnson, Useful Pl. of Gt. Brit., 214.
[10] Lindley, Morton's Cyc. of Ag., i. 234.
[11] Agr. Gazette, September 8, 1879, 218.

White, or Common Beet.

Beta alba lactucæ & rumicis folio, etc. Adv., 1570, 93.
B. alba vel pallescens, quam Cicla officin. Bauh., Pin., 1623, 118.
White Beet. Ray, 1686, 204.
Beta cicla. L., Sp., 1774, 322.
Common White-Leaved. Mawe, 1778.
White-Leaved. McMahon, 1806, 187.
Spinach-Beet. Loudon, 1860.
Poirée blonde ou commune. Vilm., 1883, 421.

This beet, a native of Sicily, near the sea-coast, as well as the shores of Spain and Portugal, was introduced into England in 1570.[1] It seems closely allied to the Swiss chard.

Swiss Chard.

Beta alba? 3. Gerarde, 1597, 251.
The Sicilian Broad-Leaved Beet. Ray, 1686, 205.
White Beet. Townsend, 1726.
Chard, or Great White Swiss Beet. Mawe, 1778.
Swiss, or Chard Beet. Mill. Dict., 1807.
Swiss Chard, or Silver Beet. Buist, 1851.
Silver-Leaf Beet. Burr, 1863, 292.
Poirée à carde blanche. Vilm., 1883, 421.

This is deemed by Ray to have been known to Gerarde (1597), for Gerarde, in his "Herbal," indicates the sportive character of the seed as to color, and mentions a height which is only attained by this plant. He calls it "3 . . . another sort hereof that was brought unto me from beyonde the seas," and particularly notices the great breadth of the stalk; but the color particularly noticed is the red sort. Ray gives as a synonyme *Beta italica* Parkinson, 1629 or 1640. It is quite variable in the stalks, according to the culture received.

Silver-Leaf Beet.

Poirée blonde à carde blanche. Vil., 1883.

A lighter green form of the Swiss chard, as described by Vilmorin, but with shorter and much broader stalk. It seems to be a variety within the changes which can be effected by selection and culture, and perhaps can be referred to the Chilian type.

[1] Booth, Treas. of Bot.; Loudon, Hort.; McIntosh, Book of the Gard., ii. 139.

Curled Swiss Chard.

Curled-Leaf Beet. Burr, 1863, 291.
Beck's Seakale Beet. Gard. Chron., 1865.
Poirée à carde blanche frisée. Vilm., 1883.

Evidently a form of the Swiss, the stalks broader, the leaves blistered and curled.

Chilian Beet.

This form is usually grown for ornamental purposes, for which they are very efficient. The stalks are often very broad and twisted, and the colors very clear and distinct, the leaf puckered and blistered as in the Curled Swiss. In the *Gardeners' Chronicle* (1844) it is said that these ornamental plants were introduced to Belgium some ten or twelve years previously. "It is yellow or red, and varies in all the shades of these two colors." In 1651 J. Bauhin[2] speaks of two kinds of chard as novelties,—the one white, with broad ribs; the other, red. He also speaks of a yellow form, differing from the kind with a boxwood-yellow root. In 1655, Lobel[3] describes a chard with yellowish stems, varied with red. The forms now found are described by their names: Crimson-Veined Brazilian, Golden-Veined Brazilian, Scarlet-Ribbed Chilian, Scarlet-Veined Brazilian, Yellow-Ribbed Chilian, Red-Stalked, etc.

The modern chards are the broad-leaved ones, and all must be considered as variables within a type. This type may be considered as the one referred to by Gerarde in 1597, whose "seedes taken from that plant which was altogether of one colour and sowen, doth bring foorth plants of many and variable colours." Our present varieties now come true to color in most instances, but some seed furnish an experience such as that which Gerarde records. It seems plausible that *B. maritima* L. is the parent form of the narrow-ribbed varieties, while *B. sicla* L. is the parent of the broad-stalked forms, and, judging from analogy, as well as by the descriptions of the wild plant, the prototypes of all the colors, and the smooth and blistered-formed leaves, probably can be found in nature.

[1] Gard. Chron., 1844, 591.
[2] J. Bauhin, Hist., 1651, ii. 961.
[3] Lobel, Stirp. Illust., 1655, 84.

Chervil. *Scandix cerefolium* L.

The leaves of chervil are aromatic, and are much used in England for seasoning and in salads.[1] It was mentioned as cultivated by Columella, Pliny, and Palladius, Roman authors of the first and third centuries. It also finds description as a cultivated plant in the botanies of the sixteenth century. It was in American gardens in 1806.[2] But two varieties are now in use,—the plain-leaved and the curled,—and these are mentioned by Petit[3] in France in 1826; and yet chervil is noted as one of the most widely diffused and best known of all pottage plants.[4]

Chervil is called, in France, *Cerfeuil;* in Germany, *Kerbel;* in Flanders and Holland, *Kervel;* in Denmark, *havekjovel;* in Italy, *cerfoglio;* in Spain, *perifollo;* in Portugal, *cerefolio.*

Chick-Pea. *Cicer arietinum* L.

This vegetable is a favorite with southern nations, and finds occasional culture among the recent emigrants to the United States, or by their descendants. While not grown on a large scale in the United States, it forms an article of extended culture in the Iberian peninsula,[5] and in India,[6] Egypt, Greece, etc.[7] The shape of the seed, singularly resembling a ram's head while in an unripe state, may account for its being regarded as unclean by the Egyptians of the time of Herodotus.[8] It was in common use in ancient Rome, and varieties are mentioned by Columella[9] and Pliny,[10] the latter naming the white and the black, the Dove, or Venus pea, and many kinds differing from each other in size. Albertus Magnus,[11] in the thirteenth century, mentions the red, the white, and the black sorts, and this mention of colors is continued by the herbalists of the sixteenth, seventeenth, and eighteenth centuries. The white chick-pea is the sort now generally grown in France, where the dried seed find large use in soups. The red variety is now extensively grown in the Eastern countries, and the black sort is described as more curious than useful.

[1] Vilmorin, The Veg. Gard., 1885, 192.
[2] McMahon, Am. Gard. Kal., 1806.
[3] Petit, Dict. du Jard., 1826.
[4] Vilmorin, Les Pl. Pot., 78.
[5] Gasparin, Cours d'Agr., iii. 796.
[6] Elliot, Bot. Soc. of Edinb., vii. 294.
[7] Unger, U. S. Pat. of Rept., 1859, 317.
[8] Pickering, Geog. Dist. of An. and Pl., 41.
[9] Columella, lib. ix. c. 1.
[10] Pliny, lib. xviii. 32.
[11] Albertus Magnus, De Veg., Jessen ed., 1867, 490.

Under the hot climate of India the plant secretes an acid, which the natives collect by spreading a cloth overnight on the plant and wringing out the dew in the morning; this they use for vinegar or for forming a cooling drink.

The multitude of the vernacular names of the chick-pea, and their distribution, indicate the presence of numerous varieties and an extended use. The European names are, in English, *chick-pea*, *Egyptian pea*, *horse-gram*, [in India] *Bengal gram*; in France, *pois chiche*, *garvance*, *café français*, *ceseron*, *ciceroll*, *ciseran*, *garvane*, *pisette*, *pois becu*, *pois blanc*, *pois ciche*, *pois cornu*, *pois de brebis*, *pois gris*, *pois pointu*, *pois de Malaga*, *tête de bélier*; in Germany, *Kitchererbse;* in Italy, *cece;* in Spain, *garbanzos*; in Portugal, *chicaro*, *grao de bico;* in Greece, *hrobithi.*

In the extra European countries it has received, among others, the following names: in Arabic, the green-seeded sort, the plant, *malaneh;* the dry seed, *homos*,[1] *hims*,[2] *al-koular;*[3] in Bengali, *chala*, *boot*, *chuna-batoola*,[2] *boot-kaley;*[4] in Egypt, *homos;*[2] in Hebrew, *ketsech;*[3] in Hindustani, *but*, *hurbury*, *chenna;*[2] in Malay, *kadala;*[4] in Persia, *nakhuda;*[5] in Sanscrit, *chanaka*, *sanakha*, *harimanthaka;*[5] in Tamil, *cadalie*,[2] *kadalai;*[5] in Telegu, *senegaloo*,[4] *senegalu*, *senaga;*[5] in Burmah, *ku-lu-bai.*[6]

Chickling Vetch. *Lathyrus sativus* L.

This in many regions is rather a forage-plant than a vegetable; but in the south and southwest parts of Europe, as in Italy and Spain, and also in Turkey[8] and India,[9] as well as elsewhere, it is grown for the use of the seed in soups, etc.,[10] as well as in the manner of green peas.[11] It has been cultivated in Southern Europe from a remote period, and finds mention by Columella[12] and Palladius.[13] According to Heuze,[8] it came from Spain into France in 1640; but this must refer to some variety, for it appears to have been well known to the herbalists of the sixteenth century, as by Dodonæus[14] in 1556, and others. It was included among American vegetables by Burr in 1863, who

[1] Delile, Fl. Ægypt, illust.
[2] Birdwood, Veg. Prod. of Bombay, 115.
[3] Heuze, Les Pl. Alim., ii. 473.
[4] Drury, Useful Pl. of Ind., 134.
[5] Elliot, Bot. Soc. of Ed., vii. 294.
[6] Pickering, Ch. Hist., 183.
[7] Decaisne and Naudin, Man., iv. 316.
[8] Heuze, Les Pl. Alim., ii. 414.
[9] Birdwood, Veg. Prod. of Bomb., 120.
[10] Bon Jardinier, 1832, 603.
[11] Noisette, Man., 1860, ii. 377.
[12] Columella, lib. ii. c. 11.
[13] Palladius, lib. iv. c. 6.
[14] Dodonæus, Frument, 1556, 113.

mentions two varieties,—the one with dun, the other with white, seeds. This latter form was mentioned by Bauhin in 1623.

The European names are, in France, *gesse cultivée*, *gesse blanche*, *lentille d'Espagne*, *dent-de-brebis*, *pois breton*, *pois carre*; in Germany, *essbare Platterbse*, *weisse Platterbse*, *deutsche Kicher*; in Flanders, *platte erwt*; in Holland, *peul erwt*, *wiken*; in Spain, *arveji*; in Spanish America, *muelas*;[1] in Italy, *cicerchia cichero*.[2]

In extra European languages: in Bengali, *khesaree*, *teora*; in Egypt, *gilban*; in Guzerat, *lang*; in Hindustani, *kussoor*; in Persian, *masang*; in Sindh, *matar*.[3]

Chicory. *Cichorium intybus* L.

The wild chicory has been used for time immemorial as a salad-plant, and, forced in darkness, affords the highly-esteemed vegetable in France known as *barbe-de-capuchin*. It has also large-rooted varieties, and these, when treated in like manner, form the vegetable known in Belgium as *witloof*.

Whether the chicory was cultivated by the ancients I think there is reason to doubt, although they knew the wild plant and its uses as a vegetable. It is not mentioned in the descriptive list of garden vegetables in use in the thirteenth century, as given by Albertus Magnus.[4] Ruellius,[5] in 1536, mentions two kinds, but does not imply cultivation; nor does Fuchsius,[6] in 1542, who likewise names two kinds, one of which is our dandelion. It is treated of by Tragus,[7] in 1552; Matthiolus,[8] 1558; the "Adversaria,"[9] 1570; Lobel,[10] 1576; Camerarius,[11] 1586; Dalechampius,[12] 1587; Gerarde,[13] 1597; but no mention of cultivation. Although not mentioned in Lyte's translation of Dodonæus (1586) as cultivated, yet in Dodonæus's "Pemptades" (1616) it is said not only to occur wild throughout all Germany, but to be cultivated in gardens; and this is the first mention of culture that I note. In 1686, Ray[14] says it is sown in gardens and occurs wild in England, and the seed occurs among seedsmen's supplies in 1726.[15]

[1] Vilmorin, Les Pl. Pot., 1883, 241.
[2] Birdwood, l. c.
[3] Heuze, l. c.
[4] Albertus Magnus, lib. vii. tract ii. c. 2.
[5] Ruellius, De Nat. Stirp., 1536, 495.
[6] Fuchsius, De Stirp., 1542, 679.
[7] Tragus, 1552, 272.
[8] Matth., Com., 1558, 258.
[9] Pena and Lobel, Adv., 1570, 82.
[10] Lobel, Obs., 1576, 114.
[11] Camerarius, Epitome, 1586, 285.
[12] Hist. Gen., Lugd., 1587, 557.
[13] Gerarde, Herbal, 1597, 235.
[14] Ray, Hist., 1686, i. 255.
[15] Townsend, Seedsman, 1726, 33.

At the present time chicory is grown for the use of its leaves in salads, and for its root to be used as an adulterant for coffee. The smooth, tapering root, which seems such an improved form in our modern varieties, is beautifully figured by Camerarius in 1586. The common chicory grown for salads is but the wild plant little changed, and with the divided leaves as figured by the herbalists. The entire leaved form, with also a tendency to a red midrib, also occurs in nature, and may be considered as the near prototype of the Madgeburg large-rooted, and of the red Italian sorts. The variegated chicory, the curled-leaved, and the broad-leaved may have their prototypes found in nature if sought for, but at present must remain unexplained. We may remark, however, that variation in nature is of very common occurrence, and quote from Vilmorin[1] that M. Jacquin has fixed from the wild sort varieties, which he has named the *demi-fine; demi-fine à feuilles jaunes; demi-blonde, forme de laitue pommee; brune, forme de laitue pommee.* These varieties are not now, however, in gardens. The common, the spotted-leaved, and the large-rooted were in French culture in 1826.[2]

The chicory, or succory, is called, in France, *chichoree sauvage, chicorée amère, chicorée barbe de capucin;* in Germany, *wilde oder bittere Cichorie;* in Denmark, *Sichorie;* in Italy, *cicoria selvatica, radicchio radicia;* in Spain, *Achicoria amarga o agreste;* in Portugal, *chicoria;* in Arabic, *hinduba, Shikorieh,*[3] *Chikourieh;*[4] in Persia, *Kasnee;*[3] at Constantinople, *korla*[5] by the Greeks; in Japan, *kio, tsisa.*[6]

[1] Vilmorin, Les Pl. Pot., 1883, 101; The Veg. Gard., 1885, 199.
[2] Petit, Dict. du Jard., 1826.
[3] Birdwood, Veg. Prod. of Bomb., 49
[4] Maillet, Desc. de l'Egypt, 1735, 12.
[5] Forskal, Fl. Ægypt.-Arab., xxx.
[6] Thunberg, Jap., 304.

(To be continued.)

CONVENTIONALISM IN ANCIENT AMERICAN ART.

BY J. S. KINGSLEY.

THE paper recently published by Prof. F. W. Putnam, under the above title,[1] is a nice piece of archæological and artistic research. The complete paper is a short one, the points being brought out by the illustrations rather than by the description in the text, of which the following is a rather full abstract.. It is, however, but just to say that the full series of illustrations elucidate the points far more completely than the few which are reproduced here.

The evolution of the ceramic art itself is an oft-told tale,—first, the clay-lined basket, and, last, the potter's wheel. The ordinary savage ornament is also well known; but occasionally one runs across, even in the pottery of the American aborigines, examples where the potter has the true artistic spirit. He has first taken a realistic representation of some familiar form, and adapted it to the vessel in hand. In course of time, as Professor Putnam says, as art increased power of expression, it progressed beyond mere realism and led to the representation of an object by certain conventional characters, without that close adherence to nature which was at first necessary to a clear understanding of the idea which was intended to be conveyed. Our author was led to a study of this conventionalism by the long series of pottery contained in the Museum of American Archæology and Ethnology at Cambridge, from the stone graves of the Cumberland Valley, in Tennessee, and the burial mounds of Missouri and Arkansas. The extent of these collections can be realized when it is said that they were derived from over six thousand of the stone graves and almost innumerable mounds, all examined in the most thorough and scientific manner. This study led to an examination of the other pottery in the museum, and it was found that a similar conventionalism was wide-spread, though not universal, and that similar artistic results by no means implied community of descent or even contact of the tribes.

To illustrate the points involved, we would first call attention

[1] Bulletin of the Essex Institute, vol. xviii., 1887.

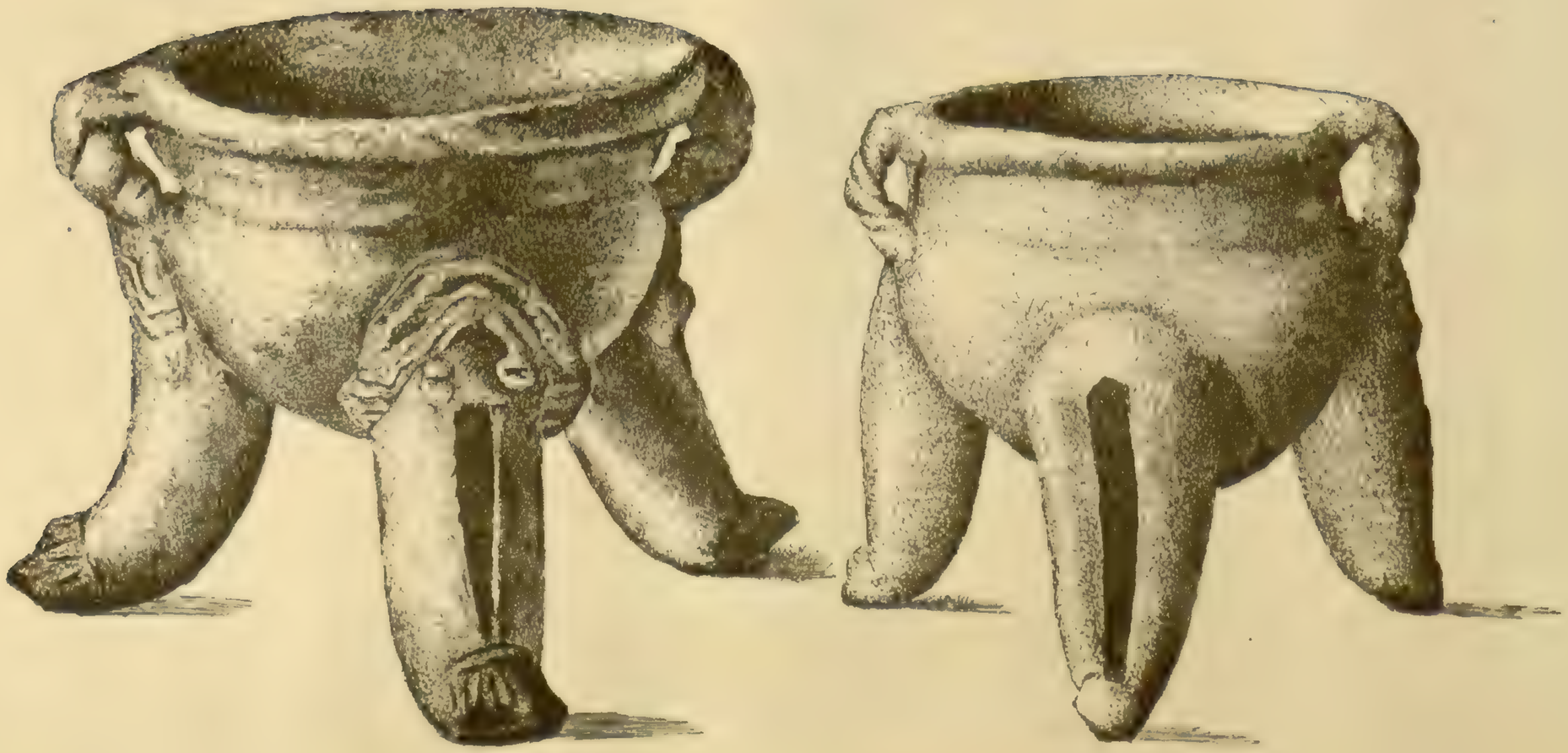
to the three-legged kettles or tripods from the ancient graves in Chiriqui, Panama, of which the museum possesses an extensive series, two of which are represented in Plate XXIV. It is well known that the primitive clay pot had a round bottom, and, to prevent this from overturning, it was propped up on stones. It marked a step in advance when the support was transferred to

FIG. 1.

FIG. 2.

the kettle itself by the addition of legs, as represented in the right-hand figure of the plate referred to. Here was a chance for the artist, and, realizing the adaptability of these legs to the reproduction of the form of a fish, he availed himself of it, as shown in the figure at the left. On each of the feet of the latter we see the wide and projecting mouth, the eyes, the pectoral

PLATE XXIV.



fins, and a forked tail. The place where the dorsal fin would naturally come was cut away before baking, so as to prevent cracking. It is noticeable that in all the specimens there is no attempt to represent the anal fin, which normally should be on the opposite or inner side of the leg.

In Figs. 1 to 4 four legs from similar pots are represented in order to show the development of the conventional idea of a fish, and especially of the dorsal fin, from a realistic representation. It should be said that a fuller series of illustrations would make

FIG. 3.

FIG. 4.

the transitions less marked. In Fig. 1 we have a highly realistic representation of a fish, in which mouth, eyes, pectoral fins, and tail are well shown, while the dorsal fin is crowded to a position in front of the eyes,—a conventional position adopted from the necessities of those legs where the slit was in the position where

the fin really would be. Here, too, the tail has become conventionalized, while the ventrals are wanting. In Fig. 2 the ventrals are shown, and the mouth, with its armature of teeth. Here, however, necessity and artistic license have stepped in, and the dorsal fin is now forced into the mouth itself, while the eyes have disappeared. In Fig. 3, though the dorsal is more nearly

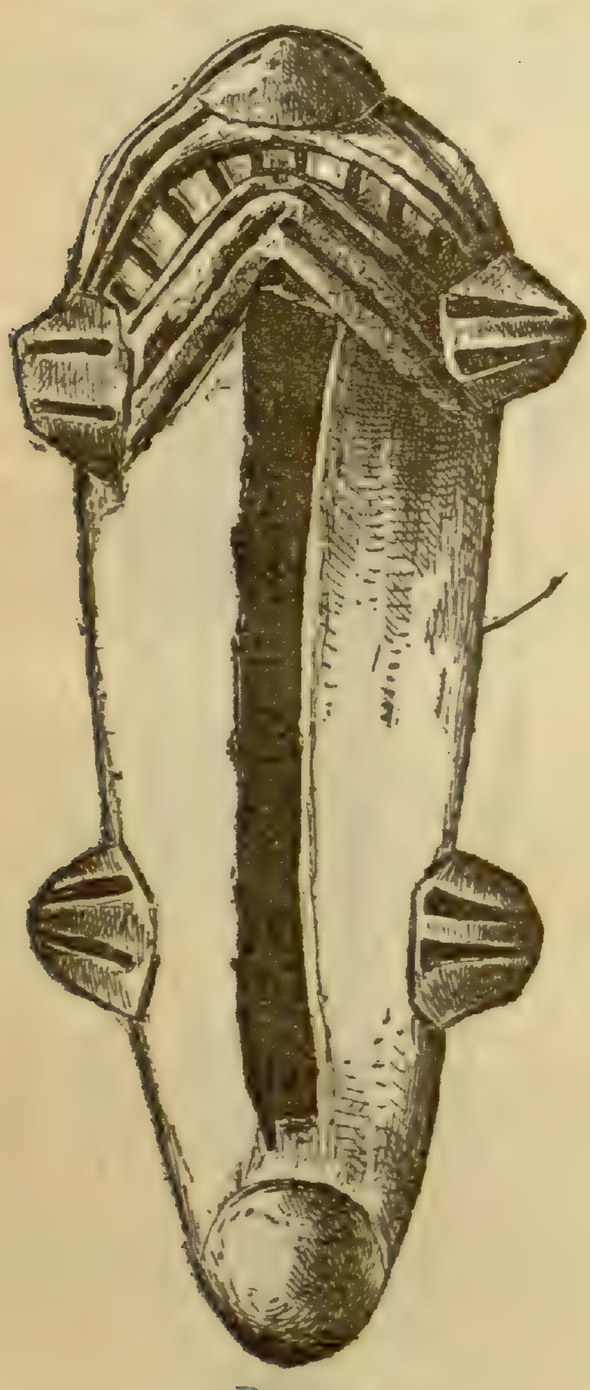


FIG. 5.

FIG. 6.

in its proper place, the conventionalism has gone further, and only a rude mouth remains to show the fish. The series reaches its extreme in Fig. 4, where all but the dorsal fin have disappeared, and yet the fact is evident, from a comparison of the series, that a fish was meant, though reduced to its simplest conventional form.

In the series represented in Figs. 5 to 8 the conventional evolution of the mouth is shown. In Fig. 1 we have the realistic mouth, but in Fig. 5 a second, beak-like mouth has been inserted in advance of the regular mouth, with its armature of teeth. Behind the true mouth are deep lines cut in the clay, as if to

FIG. 7.

FIG. 8.

give emphasis to the jaws. The pectoral and ventral fins are still of a realistic type, but the caudal is represented by a rounded knob. In Fig. 6 the mouth is represented by a projecting mass of clay above the opening in the foot, in which are deep lines corresponding to those of the last figure, while the grooved patch on either side of the opening represents the pectoral fins.

All other features have disappeared. In the next figure the pointed jaw alone is retained in the mass of clay above the opening, and in the last figure (Fig. 8) the climax of this conventionalism is reached, where all that remains of the fish consists in two pairs of oblique lines representing the jaws.

These prehistoric people of Chiriqui carved in stone as well as in clay, and were remarkable for their work in copper and gold. In all these materials similar realism and a similar development of the conventional can be traced. Other animals, even the human form, are thus treated; but in the museum collections the series of fish forms is the largest and most perfect, and hence was selected for illustration.

In the stone graves of Tennessee a similar evolution is observable. First, we have a rudely realistic representation of an animal-head upon the sides of the pot; but this has resulted in an unsymmetrical form. This was improved by the addition of knobs, which might be called nose and tail, and afterwards by handles. In the mean time conventionalism steps in, and the features, which once were highly realistic, become represented by six round knobs of equal size, and realistic work has entirely given way to symmetry, and a common cooking-pot has become chaste in style as a result of a development of artistic feeling. A somewhat similar development is traced in the ancient pottery of Nicaragua, and the result is much the same. In specimens from Arkansas the fish-like form is conventionalized upon the pot itself, and either the head and tail or the dorsal and anal fins alone remain as handles. Again, the frog was similarly treated; as were the bird, human figure, and squash. From an examination of the collections in the museum it would be easy to conclude that the jars in the shape of a woman were evolved from the squash-like form, were it not, as Professor Putnam says, that the realistic precedes the conventional in every instance.

As was said above, this conventionalism does not occur among all the peoples of ancient America. In ancient Mexico, for instance, the higher ceramic art was symbolical rather than conventional. So, too, the ancient Peruvians west of the regions influenced by the Aymaras, or their predecessors in the region of Lake Titicaca, were lacking in conventionalism, and their highest art was a realistic one, in which was often added an expression of action. In the region of Lake Titicaca another

type of art-expression existed, which seems to show a remarkable resemblance to those Old-World forms which reached its culmination in the classical type of the Mediterranean peoples.

A study of these features of ceramic art enables us to draw many interesting and important conclusions. At times, as in the case of the reappearance of the same forms similarly treated in the stone graves of Tennessee and the mounds of Missouri and Arkansas, we are led to the view that they had, at least, a point of contact. In other instances we have evidence of migrations, while, again, in other cases, where both contact and migration are out of the question, we are able to trace the development of that innate principle of the human mind which, among all peoples, finds its expression in ornament and art. We see that the artistic powers of man, like the languages, were developed in distinct centres, and from primitive forms of expression, which, of necessity, had principles in common; and this will amply account for the reappearance of the same forms in widely-separated regions. The early methods of ornamentation of pottery were by finger-marks, scratches, cross-lines, and the impression of cords and fabrics, and these are found almost the whole world over. It is only when steps in advance are taken that the art of each nation receives its distinctive impress.

COMPARATIVE CHEMISTRY OF HIGHER AND LOWER PLANTS.[1]

BY HELEN C. DE S. ABBOTT.

ON coming before a popular audience to present a special subject like Plant Chemistry, I do so in hopes perhaps of showing some of the less familiar sides of plant-life. The chief idea of the remarks I am about to make is one that has not occupied to any great extent the minds of botanists and chemists, and if it be not true, at least, no other hypothesis has been suggested than the one I will indicate to account for the chemical compounds of the vegetable kingdom.

[1] Lecture delivered in the course given under the auspices of the Philosophical, Anthropological, and Biological Societies in the United States National Museum, Washington, April 23, 1887.

On past occasions[1] I have spoken of certain chemical compounds in relation to plant morphology and evolution. The facts then advanced tended to show a chemical progression in plants, and a mutual dependence between chemical constituents and change of vegetable form, and in the following pages I will keep this idea prominently before you.

Certain condensations of force on our planet are known as chemical bodies. By usual methods they cannot be split up into component parts, hence are denominated elements. However, we have reason to believe that these so-called elements are in reality compounds themselves, formed in the cosmic laboratory from still simpler aggregations of matter.

In mineralogy the series of chemical formations are doubtlessly the result of evolution, from the more simple elements to the complex structure of the crystalline rocks.[2]

The plant kingdom may be considered as a third and higher stage; it contains in its structure combinations of the elements carbon, hydrogen, nitrogen, oxygen, sulphur, phosphorus, and compounds derived from the mineral world.

The essence which underlies all force and life may be traced through these three planes as a law of progression, little varying in its general course, though ever giving more involved problems for solution, according to the increasing complexity, from elements and minerals to plants, and even to animals.

The line separating each of these conditions of matter is indistinct, "the individual of the one encroaches upon the dominion of the other;"[3] as a spiral coil is of a single thread, so "nature in all her manifestations constitutes a unity,"[4] and the rounds of the spiral present each stage parallel, but in reality a continuation.

Analogies should not be given too much weight, but from numerous facts the above statements seem theoretically reasonable and may be provisionally accepted. The possibility of chemical evolution of the elements, in itself, is not only one of the most

[1] "Certain Constituents of Plants considered in Relation to their Morphology and Evolution." Read before the Chem. Sec. of the A. A. A. S. at Buffalo, 1886. Abstract published in the *Botanical Gazette*, vol. xi., October, 1886. "The Chemical Basis of Plant Forms." Lecture delivered before the Franklin Institute, Philadelphia, 1887. *Franklin Institute Journal.*

[2] Mineral Physiology and Physiography. By T. Sterry Hunt. Boston, 1886.

[3] The Chemical Basis of Plant Forms. By Helen C. De S. Abbott.

[4] T. Sterry Hunt, page 18.

absorbing questions of the moment for investigation, but the evolution of compounds from these elements and their possible influence upon the external forms of plants is of equal interest.

That directive force which controls the different groupings of atoms in a molecule under the solid, liquid, or gaseous forms of matter, manifests itself in still more complicated conditions in each grade of the chemical compounds of living cells, and thus from the single cell to the highest of plants is ever active.

It is not my wish to claim for plant chemistry more than the facts at my disposal will allow; though in the past, and this should not be overlooked, without the aid of the imagination to penetrate the avenues of the unknown, many of our well-established scientific facts would still be buried from sight.

The chemical analysis of the dead plant and the study of the chemical changes occurring in the living plant are among our means for some of these investigations; and much of all the knowledge derived from each field of chemical research may be utilized in aiding to unravel the mystery of these changes in the vegetable cell.

In the mineral kingdom certain elements are invariably associated with others, as nickel with cobalt; and in plants we find not only two or more compounds invariably present together,—*i.e.*, tannin and starch in the tannin groups, lime and saponin in the pink family, Caryophyllaceæ,[1] resins and saponin in all of the saponin-containing groups, and sugar and silica in the grasses, Gramineæ,—but also in certain plant groups we notice the predominance of special compounds, and their absence in other groups. The grouping of these compounds in definite association must bear some relation to their respective sequence and formation, and cannot be the result of accident. That the cinchona plant does not manufacture the alkaloids of the poppy, but each its own particular series of compounds, illustrates this.

I have said, elsewhere,[2] "the chemical compounds of plants do not occur at random. Each stage of growth and development has its own particular chemistry. . . . The result of experiment shows that the presence of certain compounds is essential to the vigor and development of all plants, and particular

[1] Die Pflanzenstoffe, by Hilger and Husemann, p. 532; E. v. Wolff, J. pr. Chem., li. 24; lii. 86; Wolff, Aschenanalysen, 1881, 144, 145.

[2] The Chemical Basis of Plant Forms.

compounds to the development of certain plants." It may be inferred that "plant chemistry and morphology are related. Future investigation will demonstrate this relation."

The theory of evolution, which underlies all mineral and organic forms, comprises the evolution of the component parts of the whole, and, since the structural bases of minerals and plants are chemical compounds, their evolution must necessarily be included in a study of plant-life. Whether this life reveals itself in the perfume of sweet flowers, or in the manifold forms of vegetation, from the simple mass of plant-jelly to the majestic forest-tree, its dependence upon matter invokes the most eager desire to acquaint ourselves with its various manifestations.

When matter, through chemical change, exhibits properties of absorption, metabolism, excretion, reproduction, contractility, automatism, and irritability, it is said to be living. In this condition it is called protoplasm. This substance is very complex and of undetermined composition, though its proximate constitution is known.[1] It is always present where life, as defined, is found, apparently the same in the lower as in the higher plants.

The lowest forms of plants, plasmodia, are irregular-shaped masses of jelly, undifferentiated in form, function, and chemical composition. This living jelly is described "as a colloidal albuminoid united with more or less water."[2]

Plant-cells, when alive, are composed of a semi-fluid albuminous substance very like the plasmodia, closed on all sides, with a watery liquid holding salts and saccharine substances in solution, and lying in contact with a firm elastic membrane called the cell-wall; also, like it, closed on all sides, and consisting of cellulose, water, and inorganic matter. Some of the Algæ and all higher plants are congregations of these cells grouped as tissues and organs, and their albuminoid contents are undergoing continual change; in life it is a building-up process, the food being supplied from the gases, water, and inorganic substances of the surroundings, and elaborated in the plant's own laboratory to meet its needs.

The vegetable kingdom does not usually claim our attention for its intellectual attainments, although its members would cer-

[1] Reinke and Rodewald, Berlin, 1881; Physiological Botany, by G. L. Goodale. 1885, p. 197.

[2] T. Sterry Hunt, Min. Phys. and Physiography.

tainly seem to possess greater chemical skill than a higher race of beings exhibit in their laboratories. Some few of this higher race are "going to take lessons" how to construct proteids and carbo-hydrates as we are told our now automatic cousins were once taught to do; though man fails to consider that it may be a lost art, and the secret has died with the plants in a "catagenetic" decline.

All plants and their products are composed of two general classes of compounds,—volatile and fixed. The former, on incineration of the plant, is transformed into gases, leaving the last as so-called **ash-constituents.**

I will very briefly refer to the sources of the substances which go to the building of the plant structure. Green plants derive their carbon from the carbon dioxide of the atmosphere, and even from complex organic compounds, since Darwin[1] has shown that insectivorous plants, by means of their modified leaves, are able to absorb flies and other small insects.

Plants which do not contain chlorophyll, as fungi, take their carbon from complex compounds of decaying organic matter. Not only do all the so-called organic compounds of plants contain carbon, but it is found also in the form of carbonates.[2]

Hydrogen is absorbed by all plants in the form of water, or ammonia and its compounds, or in complex substances, as mentioned above. Oxygen is taken up by plants free or in combination in water or in salts, and there are six possible sources of nitrogen supply; but I will not delay by going into this subject.[3]

Sulphur and phosphorus are constituents of proteids, and are derived from inorganic compounds. In addition to these the elements essential to the nutrition and maintenance of the life of all plants are potassium, calcium, magnesium, iron in the case of green plants, its absence producing the condition of etiolation; and, in certain cases, chlorine. Silicon, fluorine, manganese, sodium, lithium, rubidium, cæsium, barium, strontium, aluminium, zinc, copper, arsenic, titanium, iodine, and bromine have also been found among the ash-ingredients of certain plants.

[1] Insectivorous Plants. [2] Ann. Phys. et Chim., Berthelot.

[3] The Economical Aspect of Agr. Chem., by H. W. Wiley, Proc. A. A. A. S., vol. xxxv., 1886.

These ash-ingredients are usually present in each plant-cell in the cell-wall, imbedded in the cellulose and partly in the contents of the cell. The salts of the alkaline metals, sulphates chlorides of magnesium and calcium, also soluble silicic acid as in *Equisetum hiemale*,[1] occur in solution in the cell-sap, and insoluble salts exist in the tissues of plants.

The differences in the composition of the ash of plants show that each plant is endowed with a specific absorbent capacity; thus a gramineous plant[2] is able to withdraw relatively large quantities of silica from the soil than a leguminous plant. The latter can only do so to a very slight extent.

The absorbent capacities of allied species are very different. Again, individuals of the same species yield different ash-constituents, depending upon their vigor, and at different periods of growth the ash-composition varies. In a summary of experimental results it has been stated that[3] "similar kinds of plants and especially the same parts of similar plants, exhibit a close general agreement in the composition of their ashes, while plants which are unlike in their botanical characters are also unlike in the proportions of their fixed ingredients."

Certain marked varieties of plants appear to be peculiar to and developed by certain soils, as the violet, *var. calaminaria*, and the penny cress, in zinc soils.[4] In the leaves of the latter plant thirteen per cent. of zinc oxide was found, and I have found manganese in the different portions of *Yucca angustifolia* grown near Lake Valley, New Mexico.

Plants may absorb from the soil mineral matters independently of their use or harmfulness to the plant, but the absorption of essential inorganic constituents will depend upon their relation to the changes in the vegetable cell.

The ash-constituents of a plant increase from the roots upward to the leaves, the largest percentage being found in the younger portions of the growing plant, and I have observed this same principle on a more general scale running through the entire plant kingdom, for the largest ash-percentages are found among those plants lower in the evolutionary scale, which would

[1] Lange, Ber. d. deut. chem., Ges. xi. [2] Wolff, Aschenanalysen, 1871.
[3] How Crops Grow, by S. W. Johnson, London, p. 145.
[4] A. Braum and Risse, Sachs, Exp. Physiologie, 153.
[5] Amer. Phil. Soc. Trans., H. C. De S. Abbott.

correspond to the larger ash-percentage of younger, or formative, parts of the growing plants. Some of these lower groups, as the diatoms of the Algæ and the vascular cryptogams,[1] contain enormously large ash-percentages; in the Horse-Tail, *Equisetum*,[2] 60 per cent. alone of silicic acid. The *Lycopodium*,[3] in addition to 14 per cent. of silicic acid, contains 27 per cent. of alumina and 2.5 per cent. of manganese. Among comparatively lower plants the willow and poplar[4] are rich in ash-constituents; the former[5] contains 1.53 per cent. of manganese. Members of the sedge order and grasses contain large quantities of silica; the rice-hull, 98 per cent. Various species of apetalous plants on the same evolutionary plane with these groups also contain a large percentage of ash-constituents, as the *Salicornia*, *Salsola*, *Chenopodium*, and *Atriplex*, also the Sugar-Beet.

I have stated what chemical elements are essential for the life of the lower, as well as the higher, plants; also those which may occur in certain plants; and I have spoken of the two general classes of compounds of which plants are built as the volatile and ash constituents. The four elements carbon, hydrogen, oxygen, and nitrogen enter into the composition of the first class of compounds, and the grouping of these elements with each other and to the ash-elements constitute what is called plant chemistry.

As certain chemical elements are always present in plants, so certain changes occur and compounds are found generally, more especially among the albuminous constituents. However, even this statement should be restricted to saying that the first chemical reactions between these elements are probably identical at the start, the subsequent compounds formed depending upon the evolutionary stage.

The infinite variety of these compounds is only equalled by the numerous genera and species of the vegetable kingdom; though certain compounds frequently occur, as starch, sugar, tannin, and other bodies, correlated in special groups of plants with special and distinct properties. For example, the true

[1] Die Pflanzensenstoffe, p. 323, W. Lange; Bil. Ver., xi. 822.
[2] Ann. Chim. Phys., xi. 62, 208; Ann. Chim. Pharm., 77, 295.
[3] Flückiger, Pharmacognosie, Kamp; Ann. Chim. Pharm., 100, 300.
[4] Durocher and Lalaguti, Liebig's agric. Chemie, 8 Aufl., 371.
[5] E. Riechardt, Chem. pharm. Centralbl., 268, 567.

starch of the cryptogams will be found gelatinous in Algæ, replaced in Fungi as glycogen, and only in the lowest of the flowering plants does it occur in the simplest stratified form; from this stage to the highest of plants, the Compositæ, in which it occurs as a crystalline substance called inulin, it may be traced from plane to plane of plant-group development in a succession of stratification until it reaches its highest point in our most evolved plants. So strongly marked are these varieties of starch-forms that some investigators, notably Nägeli, have proposed this means for the identification of many plant families.

The many kinds of vegetable sugars known to chemists also have their locations, not only during different stages of the individual plant-growth and in different parts of the plant, as synanthrose,[1] the especial sugar of the unripe grain of rye and wheat, but also in certain families, some one kind of sugar will predominate in many of the individuals. The tannins of the oak, beech, and poplar are not those of the higher plants.

At a certain stage of plant evolution, glucosides, substances capable of splitting up and yielding, among other products, sugar, appear. I have observed in those plants where large percentages of such substances are found a diminished proportion of starch and sugar,[2] or their absence, notably in soap-bark and species of the *Yucca*.

The waxes, oils, camphors, resins, acids, and other classes of vegetable compounds might be similarly cited as offering characteristic properties in various plants in which they appear, but the examples given are ample to illustrate my point, that the chemical compounds of plants should be considered from three sides, viz.:

1. In their own development through many plant groups from a gelatinous or undifferentiated compound to a polymer, or a substance of the same chemical formula having a solid or crystalline form.

2. In their succession of changes which may be observed during the different stages of the individual plant's growth, and the relation of these chemical changes to other compounds present in the plant.

[1] Ripening of Seeds, by A. Muntz, Ann. Agronom., xii. 399, 400; Jour. Chem. Soc., Feb. 1887, p. 173.

[2] Trans. Amer. Phil. Soc., *Yucca angustifolia*.

3. The location as predominant of some one or associated compounds only in certain plants on similar evolutionary planes.

These three conditions correspond to what was stated at the beginning, that a law of universal progression may be traced wherever matter or force exists.

There is no absolutely certain knowledge of the precise character of the chemical changes which these plant compounds undergo, though we have some information about them. Investigations are being vigorously pushed in this department of plant-life, and it may be reasonably inferred that definite facts will be obtained on many of these subjects.

It would seem from the latest researches that the albuminous or proteid compounds to which life is essentially linked are formed from a compound containing nitrogen, called an amide, and some carbo-hydrate; its sulphur and phosphorus supply being derived from inorganic sources. This amide is probably asparagine or a related body. Various suggestions have been offered to explain its formation in the plant, from the breaking down of protoplasm to its construction from simple nitrogenous and carbon compounds, and among the latest investigations,[1] the results show that the formation of asparagine is independent of carbo-hydrates, and that the amide formed is not a by-product of the interchange of matter within the plant. The author of these experiments considers that asparagine is formed by the union of inorganic nitrogen compounds and malic acid within the plant, the acid being derived from the carbo-hydrates.

Other nitrogenous compounds, as the alkaloids, for example, are probably formed from the complex albuminoids, and in fungus plants which are especially rich in nitrogenous compounds alkaloids are common.

It has been generally held that alkaloids with resins and some other compounds occurring in plants are waste products, but this cannot be accepted as final. The researches[2] of Selmi, Gautier, Etard, Brieger, and others have broken down an imaginary distinction between plants and animals which is of interest in this connection. They show that the production of

[1] O. Müller, Landw. Versuch. Stat., 1886, 326–335; Jour. Chem. Soc., p. 70, Jan. 1887.

[2] Les Alcaloides d'origine Animale. Par Dr. L. Huhouneng, Paris; Chem. News, Dec. 10, 1886.

alkaloids is a general function common to all living cells, whether they be Bacteria or the cells of living animals.

In the animals with their excretory functions these poisonous substances would be readily eliminated from the system, but it seems to me that in the absence of homologous organs in plants these compounds might be used again for the building up of tissue and prevent the accumulation of products detrimental to plants, and the recent investigations of Kellner[1] on the composition of tea-leaves show that this view is not unlikely, for he states that the non-albuminoid nitrogen is almost wholly absent during the latter stages of growth, being found as theine; in the seeds the albumen has increased, but no theine is found, thus the author believes that positive proof is afforded that the alkaloids are a decomposition product of albumen, and capable of again forming albumen like asparagine and glutamine.

It will not be possible in this place to enter more fully into the details of the chemical changes going on within the plant. My time will not allow a discussion of the changes of starch into sugar, and conversely, nor a review of the many steps in the transformation of protoplasm into the simpler products of cellulose, chlorophyll, and other substances; and it may be well to say that the ideas of physiologists in regard to these changes are unstable, since the acquisition of new facts seems to unsettle former opinions. But, to illustrate the revolution within the last few years from former views held in plant chemistry, I will mention that sugar is not, in all plants, a reserve or plastic body, and in some few (for example, the sorghum-cane[2]) it must be regarded rather as a waste product, and its advent in larger percentage after the maturity of growth marks the decay of the plant and attends its euthanasia.

I have desired, by entering into all of the above particulars, to prepare for a consideration of the compounds which are formed by these chemical successions and occur through the plant kingdom. In treating of this subject I shall have so frequent occasion to speak of the different plant families that, for convenience, I shall use the order of evolution for flowering plants proposed by M. Édouard Heckel,[3] and which is represented in the table.

[1] Landw. Versuch. Stat., 1886, 370, 380; Jour. Chem. Soc., Jan. 1887, p. 73.

[2] On the Variations of Sucrose in Sorghum Saccharatum, by H. W. Wiley. Botanical Gazette, vol. xii., March, 1887.

[3] Revue Scientifique, 13 Mars, 1886.

SCHEME OF PLANT EVOLUTION.

BY M. ÉDOUARD HECKEL.

Cephalization. Simplification of Floral Elements. | *Metamerization.* Multiplicity of Floral Elements. | Simplicity of Floral Elements. | *Processes.*

Serpentaires. | Daphnales. | Monimo-Urtico Polygonales. | Spadiciflores. | Amentales.

Apetalous.

Casuarineæ, Myriceæ, Juglandeæ, Salicineæ, Carylaceæ, Cupuliferæ, Betulaceæ, Balsamifluæ, Plantaneæ. — Fluviales.

Piperaceæ, Ceratophyllaceæ, Chloranthaceæ, Saurureæ, Datisceæ, Nepentheæ. — Spadiceæ.

Monimiaceæ, Urticeæ, Cynocrambeæ, Canabineæ, Ulmaceæ, Celtideæ, Moreæ, Polygoneæ, Amarantaceæ, Baselleæ, Chenopodeæ, Artocarpeæ. — Glumoideæ.

Phytolaccæ, Laurineæ, Myristicaceæ, Santalaceæ, Loranthaceæ, Cytineæ, Balanophoraceæ, Begoniaceæ, Elæagneæ, Proteaceæ, Thymeleæ, Nyctagineæ. — Liroideæ.

Asarineæ, Aristolochiaceæ. — Gymandres.

Monocotyledons.

Lemnaceæ, Naiadeæ, Potameæ.

Jugcagineæ, Aroideæ, Pandaneæ, Cyclantheæ, Palmea, Typhaceæ.

Cyperaceæ, Gramineæ, Restiaceæ, Eriocaulaceæ, Xyrideæ, Juncæ, Commelyneæ.

Liliaceæ, Irideæ, Alismaceæ, Butomeæ, Hydrocharideæ, Pontederaceæ, Taccaceæ, Bromeleæ, Tillandsiæ, Musaceæ, Zingiberaceæ, Cannaceæ.

Apostasiaceæ, Orchideæ.

Dicotyledons.

Cupuliflores.

Rosales, Ficoids.

Thalamiflores.

Polycarpels, Hydropeltideæ.

Cruciformes-Euphorbiales, Pariétales, Tilio-Malvales, Gamopetelous-Isogynes.

Gamopetalous-Anisogynes, Labiatiflores.

Epicorolliflores.

1. Corysanthérie.

Caprifoliaceæ, Campanulaceæ, Lobeliaceæ, Valerianeæ, Dipsaceæ.

2. Synanthérie.

Cucurbitaceæ, Brunoniaceæ, Stylidieæ, Compositæ.

The author classes all these plants under three main parallel divisions, from the lowest of the apetalous,[1] mono- and dicotyledonous groups to their respective highest plants. These three main columns are divided at the same point into three general planes. On plane 1 are all plants of simplicity of floral elements or parts; for example, the black walnut with the simple flower contained in a catkin. On plane 2 are plants of multiplicity of floral elements, as the many petals and stamens of the rose; and, finally, the higher plants, as the orchids among the monocotyledons, and the Compositæ among the dicotyledonous plants, come upon the third plane, or the division of condensation of floral parts.

These three characteristics, simplicity, multiplicity, and condensation of floral elements, are correspondingly repeated in each of the three horizontal planes, and even in individual orders in their lowest and highest plants.[2] To facilitate the comprehension of this classification I have assembled a sufficient number of the plants themselves, so arranged as to place before you a living representation of this complicated diagram.

(To be concluded.)

HORNLESS RUMINANTS.

BY R. C. AULD.

THE group of mammals known as Ruminants exhibits certain characters more or less dependent and highly typical. Among these is the possession of horns. The Ruminants are the only recent mammals provided with bony extensions of the

[1] Heckel's division of apetalous plants from mono- and dicotyledonous groups has been criticised by some botanists as an artificial method of classification. Since all botanical classifications have been declared, on botanical authority, in a measure, artificial, the author does not feel called upon to apologize for introducing M. Heckel. She has found his scheme to answer her purposes, provisionally, more fully than other classifications, and she is indebted to him for a means of presenting her subject, which would be otherwise impracticable. Further than this she is not responsible for advocating the classification. M. Heckel's table is published with his paper, "Les plantes et la théorie de l'evolution," in the *Revue Scientifique*, 13 Mars, 1886.

[2] Plate XXV. illustrates this principle for the three horizontal planes, which is also applicable to the orders.

PLATE XXV.

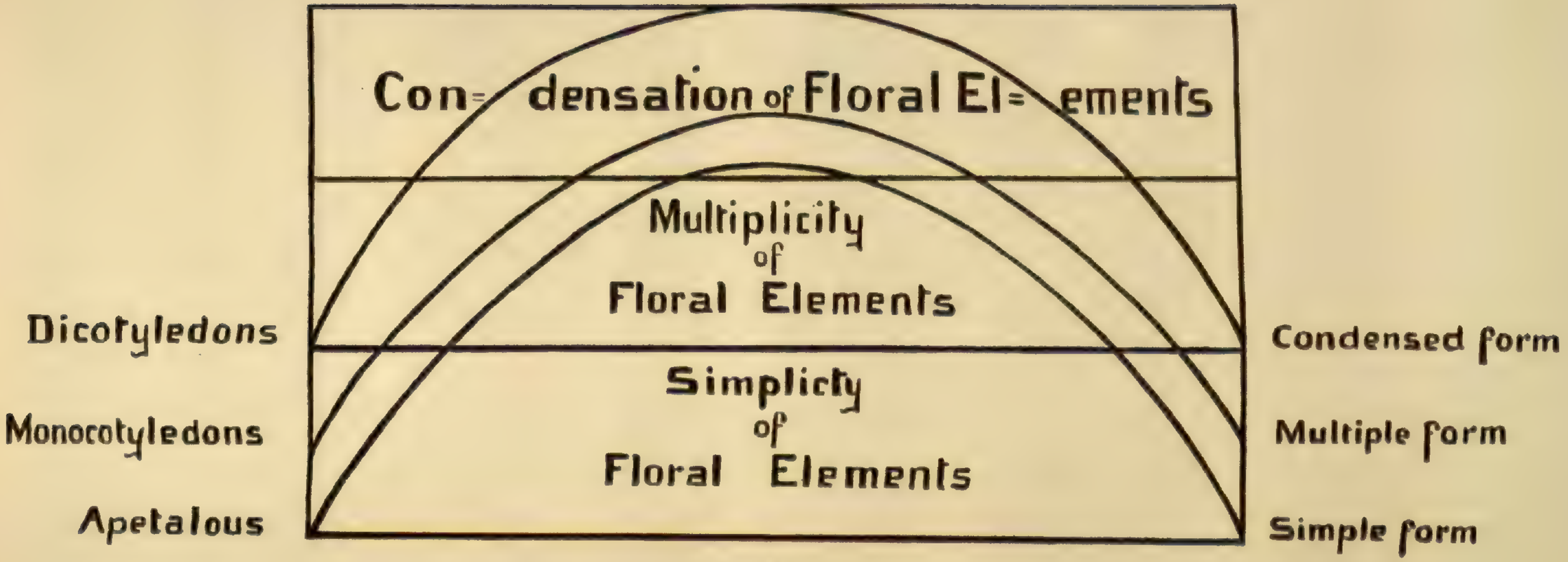


PLATE 1.

frontal bones, to which may be attached, or round which may be sheathed, horny appendages or coverings. But all of the group do not possess these; camels, etc., and two tribes of deer are normally hornless. And among the others, as it is our object to show, the horns are by no means constant, or even necessary. In reference to their horns, Ruminants may be thus arranged:

a.	Camels (including Llamas, etc.) . . .	Without horns.
b.	Giraffes, horns persistent.	Solid horns.
c.	Deer (including the hornless deer), horns deciduous.	Solid horns.
d.	Antelope, Goats, Sheep, Oxen, horns persistent[1]	Sheathed horns.

In reference to the particular character that is to engage attention, the group may be divided in two divisions:

I. Normal hornless Ruminants.
II. Special hornless Ruminants.

I. Normal Hornless Ruminants.

Camels, llamas, alpacas, guanacos, chevrotains, water, and musk-deer are the normal hornless Ruminants, in both sexes. All these have, however, efficient canine teeth.

II. Special Hornless Ruminants.

Under this division come all those instances, among others than those just named, which it has been the object to investigate.

Giraffes.—Though the giraffe seems normally to be horned in both sexes, a description of the horns is necessary. The head is adorned with three prolongations of the bone, two of which, in the usual place of horns, are generally described as such. They are covered with a velvety skin similar to those of the deciduous-horned deer at their first growth, but which does not fall off; and at the tip they are surmounted by strong bristly hairs. In the adult the internal structure is hard and solid, but in the young there has been observed an appearance of a cellular centre, nourished by vessels. The third protuberance is in the centre of the skull, and appears as a rounded knob, and is of a very spongy texture (*Jardine*). Both sexes are born with the horn of a certain distinct development; they are persistent

[1] I know of exceptions to this.

throughout life. I have not discovered any instances of the absence of these peculiar horns. But their structure in their earlier stages seems somewhat similar to some developments in hornless deer, etc.

Deer.—In deer the horns are solid. They have a peculiar manner of growth familiar to most. After the third year, when their horns are named "antlers," they are annually shed and annually reproduced in a more and more complex manner till they attain their limit of "royalty" and maturity. This process, as will soon appear, it is of the utmost interest to notice. It may be termed the individual-life development, and this it will be of importance to compare with the species-life development. With a single exception of the Arctic reindeer, all female deer are normally hornless. The exception in this case must prove of advantage to the female of this species. It may enable her by the shovel-like processes that overhang the brow, to procure access to food in her snow-bound home. Abortive or rudimentary horns occasionally appear in female deer. The male also is *frequently* without them.

Lord Walsingham and Sir Ralph Payne-Gallway, Bart., in their book on "Shooting" (Badminton Library) give some interesting notes on Deer by Lord Lovat, who says, "Sometimes stags have no horns. These are called humle stags. If naturally so, and otherwise perfect, they will thrash any other stags of their own or even considerably greater weight. We have known several of them undisputed masters of large herds."

The late Mr. Horatio Ross, the famous sportsman of Ben Wyvis, Inverness-shire, Scotland, shot a hornless stag in the autumn of 1880. Mr. Ross then wrote: "When I tell you that I never before saw a similar stag dead, you see that it must be a rare specimen. It is a 'hummelled'[1] stag. I have frequently in this great forest seen hummelled stags,—that is, full-grown stags without horns. I once shot a stag of that description at Invermark. The stag killed the other day is a splendid animal, weighing 16 stones, perfectly clean."

In a note in the "Naturalist" department of *The Field* (London) I made reference to one of the hornless stags of Ben Wyvis, and to that note Mr. Edward Ross, son of the gentleman just mentioned, writes thus, March 1, from The Rounds, Wimbledon:

[1] Scotch for hornless.

"Allow me to say that hornless or 'hummel' stags, as they are termed in the Highlands, although seldom shot, are not quite so rare as is often supposed. When a herd of stags is found the telescopes of the sportsmen are usually directed towards those with the finest horns, and thus the 'hummels' are apt to escape notice in the crowd; but whenever a herd of several hundred stags is collected together, it will be found, oftener than not, if carefully examined with the glass, to contain one or more 'hummels.' The stag whose head your correspondent refers to was shot by me six years ago in Ben Wyvis Forest, Ross-shire, where it had been known for several years. At the time I shot it it was in company with about three hundred and fifty other stags, among which I observed two other 'hummels' younger than the one which I killed.

"In point of size and condition, these stags are in no respect inferior to their horned brethren. The stag referred to weighed over sixteen stones, and I recollect seeing another, shot by the Duke of Westminster in the Reay Forest, Sutherlandshire, which also exceeded sixteen stones weight, both of these being weighed 'clean,'—that is, without heart, liver, or entrails.

"Strange as it may seem, a full-grown 'hummel' is sometimes very formidable in fight. I have seen one during the rutting season in possession of a large herd of hinds, who succeeded in driving off all his horned rivals.

"Although devoid of horns, the heads of those which I have seen have had slight excrescences, concealed by hair and covered with skin, at the top of the head where the horns ought to have grown. I have never examined the bare skull of one of these deer, but the excrescences which I have noticed have not had either the size or the shape of the stump of bone attached to the skull from which horns grow, and have had no appearance of ever having borne horns. I have never doubted, nor heard it questioned by others experienced in Highland deer-forests, that these stags are hornless from their birth.

"'Haviers,' as stags which have been altered when calves are termed, have no horns, as is well known, and in the early part of the season these, seen through the glass, might be mistaken for 'hummels'; but as the season advances the necks of the latter swell, and (except in the matter of horns) they assume all the characteristics, both in appearance and behavior, of ordinary stags, and are thus easily distinguished from 'haviers.'"

H. von Nathusius, Altaldensleben, province of Saxony, supplies the following interesting notes:

"Hornless stags are of no rare occurrence in some parts of Germany. I know of their occurrence in a wild state in the Harz Mountains and in the royal deer-forests of the Görde in

the province of Hanover, and Letzlingen in this neighborhood (province of Saxony). They are called by the people 'büffel,' 'flattköpfe' (flatheads), 'hermits,' and perhaps by other popular names. The last name is derived from the former opinion that they are not fertile, although it is beyond doubt that they are so, and produce a large percentage of hornless progeny. They are killed wherever they are met with in well-preserved forests, and therefore are now scarce. The cause of this defect is attributable to insufficient food and close inbreeding. The Görde and Letzlingen are fenced with timber, mostly fire-wood. So far as I know them from my own experience, these hornless deer are very massive, but not high on the leg, and, as they are much persecuted, they are seldom full grown. I shot one at a royal battue in the forest of Letzlingen on November 13, 1874. He was rising three years, judging by the teeth, but badly developed and very poor in venison; he had evidently been rutting, and from the big neck and mane, could not be mistaken for a hind, though there was but a very small protuberance on the head. I preserved the skull. The 'Hornzapfen'—*i.e.*, the bony excrescence on which the horns had to grow—in this case slightly

FIG. 1.—Head of Hornless Stag.

pierced the skin, but were covered by hair. This varies, however, in hornless stags. I have another skull where the 'Hornzapfen' were entirely covered by the skin; and it is no rare occurrence to find an undeveloped formation of horn on the bone, but only the base or Rosenstock, as it is technically termed, with a flat top reaching through the skin, but covered almost with hair. Such skulls from the Harz are in the possession of Baron Gussert and Herr von Asseburg. The man who perhaps knows most about hornless stags is the Königlicher Förster Pookh, Forsthaus Röthen, Görde, province of Hanover.

"In the *Illustrirte Zeitung*, published in Leipzig, October 2, 1886, there is a head of a hornless stag (Fig. 1) and a fight between a horned and a hornless stag, drawn from life by Beckmann, an artist who often contributes sporting sketches to the English illustrated papers. This picture confirms the opinion that hornless stags hold their own against antlered ones. It is perhaps of interest that at Letzlingen, where some thousand fallow deer are kept, together with some hundred red deer, hornless bucks never occur among the former."

One of these skulls is now in the Museum of the University of Cambridge.

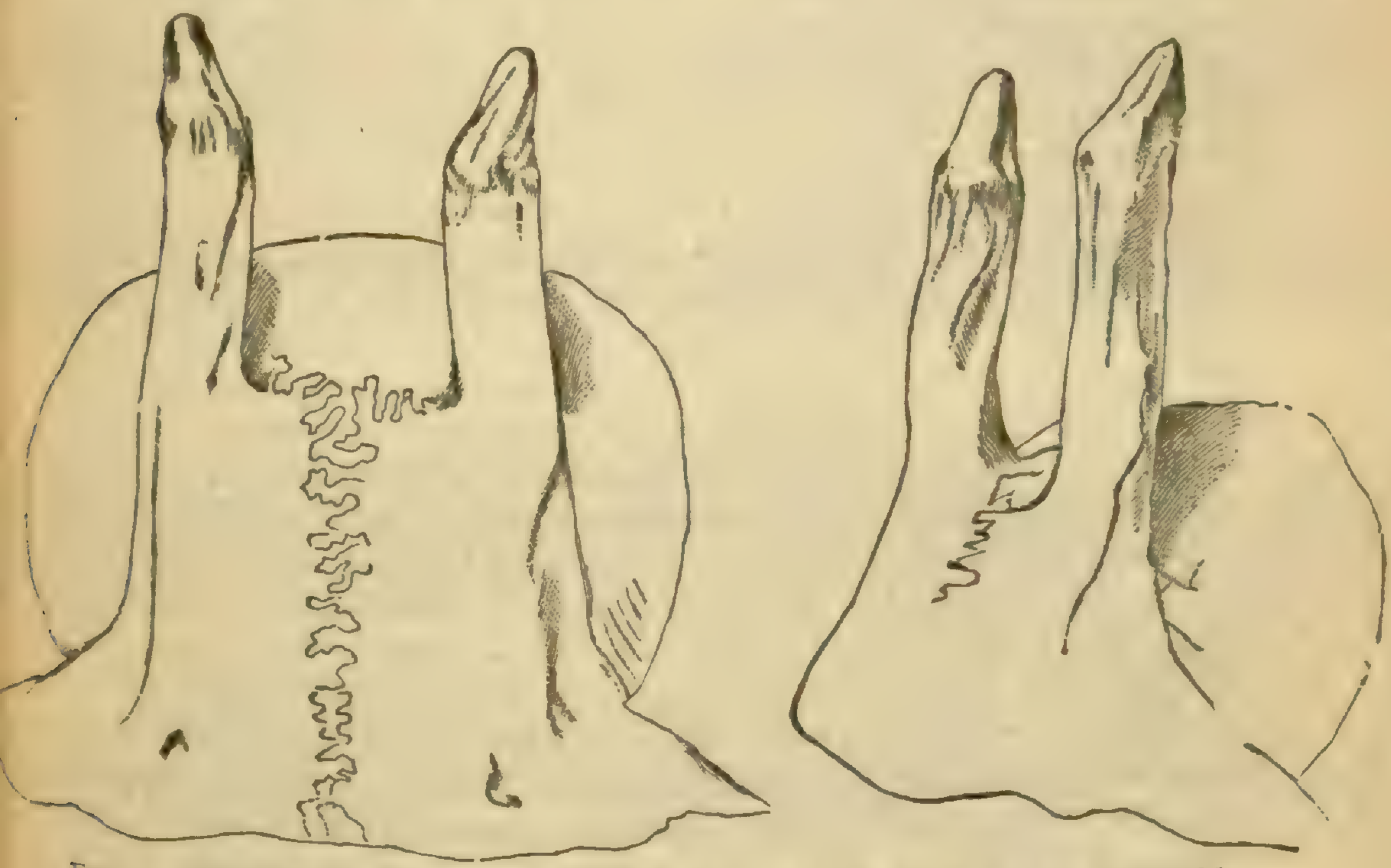


FIG. 2.—Skull of adult Hornless Roebuck (life-size) shot, July 7, at the halduishle, province of Saxony, Prussia.

"Since the above was written," Herr von Nathusius writes me, "I have got notice of a hornless roebuck (*Cervus capreolus*) that had been shot some years ago in this neighborhood. I enclose a sketch" (Fig. 2). The following notes are from Ludwig Beckman:

"Having long been familiar with hornless stags as annual visitors to the Göhrde Forest, perhaps the following notes on the subject may be of interest:

"In the German sporting literature both hornless and single-horned stags are mentioned since the seventeenth century. The former were regarded as unfertile, and called 'monks'; the latter were known as 'murderers,' because they were suspected to be

dangerous to the normally horned stags in fighting. In none the deer-forests were they found in any number, but appear here and there singly, seldom leaving any progeny, as they were generally soon destroyed. In Behlen's *Forst und Jagdzeitung* for the year 1831 there is the following notice: 'Remarkable stags in Göhrde.—There have been observed of late years stags with only one horn. The keepers and foresters assert that these single horns are shed annually, and that the animals show no signs of infirmity.' In the same year (1831) a hornless stag was killed in another forest (Evensen) near Hanover, which had evidently been rutting hard. In July, 1832, a hornless stag, weighing nearly two hundred kilogrammes, was killed in the shooting of Graf Bernstorf, Gartow. This stag was first observed in the rutting season 1829, with a herd of fifteen to eighteen hinds chasing the horned stags by striking at them with the fore-legs. In 1850 I found skulls of single-horned stags in several collections at Hanover, and heard from the royal foresters that there were more in Göhrde, and that this variety would be preserved. Subsequently the destruction of the hornless stags at Göhrde was often contemplated, but, to my knowledge, was never earnestly carried out, for it was evident that the experiment would not be of much use. Hornless stags are often regarded as a peculiar variety, but then so are stags with only one horn,—in fact there are so many individual variations of this kind, that it is impossible to draw a line between stags with and without horns in places where hornless stags have long existed.

"In the Göhrde Forest, where neither 'flat-heads,' or hornless stags, nor single-horned stags, are rare, I found, in 1883, among the forty-five stags killed at the royal battue, perhaps five or six warrantable stags, with fully-developed horns; twenty-five middle-sized and small, but with rather regularly-shaped horns; one old stag with only one fully-developed antler on one side and a short boss[1] on the other side; some heads with an antler only half developed, and one boss projecting, more or less, through the skin of the forehead. Then followed two perfect hornless heads with bosses, but, of course, covered entirely with skin. Among other deer killed that day were several young stags with thin slender horns of a white color, resembling bleached horse-ribs ('switch-horns'), while others were bent and twisted like corkscrews. The difference between the undeveloped bosses of a hornless stag, like Fig. 3, and that of a warrantable stag, with well-developed horns, may easily be seen by comparing Fig. 3 with Fig. 4, the latter having been sketched after the annual shedding of the horns. Some hornless stags have only small flat rudiments of bosses, which are not visible until the skull is stripped of its skin.

[1] In German, Hornzapfen or Rosenstad.

"The bosses of a flat-head, or hornless stag, never produce or bear horns. These flat-heads, as well as the single-horned stags, are nevertheless fertile, their necks swelling, as usual, towards the rutting season, when they are roaring and fighting with the horned stags. They attack a rival by raising themselves on their hind-legs and striking at them with the fore-legs. Generally the horned stag adopts the same mode of fighting, without using his more dangerous weapons, the horns, as I have often observed.

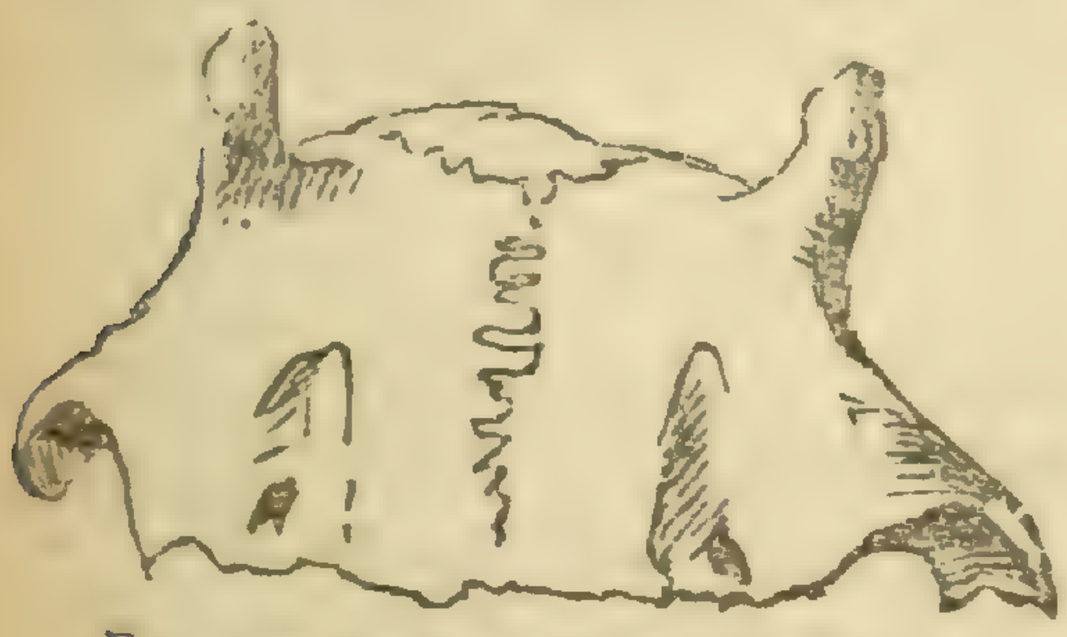


FIG. 3.—Skull of Hornless Stag.

FIG. 4.—Skull of a Horned Stag, after shedding the horns.

But I have been told by foresters and keepers that they have sometimes seen hornless stags fighting with antlered rivals forehead to forehead; and Oberförster Wallmann, in Göhrde, once saw a hornless stag in this way pressing and driving away a horned rival from a lot of hinds. I can only explain this by the fact that hornless stags are often superior in bulk and weight to horned ones. The loss of horns in male deer is certainly not the result of long inbreeding. In the Göhrde Forest, where from five hundred to six hundred deer roam over an area of five thousand hectares, and where the fences have openings (einsprünge), so that the wild deer may enter at any time, no such inbreeding takes place. It is well known in that district that in former times wild stags came during the rutting season even from Mecklenburg, across the Elbe. In the royal forest near Springe, in Hanover, which is surrounded by high walls, and where the deer have been breeding in and in for forty years, the stags have nevertheless well-developed horns, and Oberförster Hesse, of Springe, told me that not a single hornless stag had been observed during all that time."

The musk-deer, smaller than the roebuck, differ from the general character of deer in having no horns in either sex. "To compensate the want of horns" the males have two long and slender canine teeth, which project from the jaw like elephants' tusks, only that they curve inwards. In this tribe the canines, instead of being arrested in their embryo stage, as in the other common Ruminants, gain full development. The musk-deer (*Moschus moschiferus*) are natives of Thibet and Nepaul.

The water-deer (*Hydropotes inermis*) is a singular deer without horns, and with large projecting canine teeth. It is found in China in the low meadows and scrubs bordering the rivers, and is remarkable for its excessive fertility, the female being said to produce six or seven young at a birth.

"In the large riverine islands of the Yangtsze, above Chinkiang," Mr. Swinhoe tells us, "these animals occur in large numbers, living among the tall rushes that are there grown for thatching and other purposes. The rushes are cut down in the spring; and the deer then swim away to the main shore and retire to the cover of the hills.

"In autumn, after the floods, when the rushes are again grown, they return with their young, and stay the winter through. They are said to feed on the rush-sprouts and coarse grasses, and they doubtless often finish off with a dessert from the sweet-potatoes, cabbages, etc., which the villagers cultivate on the islands during winter.

"Fortunately for the deer, the Chinese have an extraordinary dislike for their flesh. They are therefore only killed for the European markets, and sold at a low price. The venison is coarse and without much taste, but is considered tolerable for want of better; it is the only venison procurable in Shanghai."

Specimens of the latter are to be seen in the Zoological Society's Garden, London.

Passing from living to extinct forms of deer, there has to be noted the discovery of polled or hornless skulls of the extinct Irish elk. But some much more remarkable discoveries have been made in the history of the species-life or development. It is found that the horn-development, in complexity, is exactly parallel to that seen in the development of horns in the individual of to-day. Professor Boyd-Dawkins[1] states that in the lower meiocene "no member of the family is possessed of antlers." They are hornless,—polled. In the mid-meiocene strata Professor Gaudry notes small branching erect antlers persistent throughout life, and characterized by the absence of a burr. This is considered by Professor Leidy as a form intermediate between the antlers of deer and the horns of the antelope. It may fairly claim to be the most rudimentary form of antler belonging to a type no longer represented. The true starting-point of the antlered deer of the post-meiocene age is presented by the simple forked crown of the *C. dicroceros* of the mid-meio-

[1] Early Man in Britain.

cene. The cervine antler of the upper meiocene becomes more complex, but is still small and erect, like that of the roe. In the pleiocene it becomes longer and longer, and altogether more complex and differentiated, some forms, such as the *C. dicranios*, being the most complicated known either in the living or fossil state. These successive changes are analogous to those which are to be observed in the development of the living deer,—which begins with a single point, and increases the number of tines till the limit is reached. It is obvious from the progressive diminution in size, and complexity of the antlers in tracing them back from the pleiocene into the mid-meiocene of Europe, that in the latter period we are approaching the zero of antler development. In the lower meiocene Professor Boyd-Dawkins has failed to meet with evidence that the deer possessed any antlers.

Thus in deer the polled head was the condition of the family during its embryo age of development, as it is in the living individual to-day. This was during the upper eocene period, "when generalized or ancestral forms of deer and antelope" were universally of the hornless type, whose associates were, also, tuskless Suidæ and hornless Rhinoceri.

Antelopes.—The indications, as just pointed out, of the earliest forms of antelopes are that in such stage they were unpossessed of horns. Darwin notes that, "with the antelopes a graduated series can be formed, beginning with the species the females of which are completely destitute of horns, passing to those having small rudimentary to those which have fairly well-developed horns, to those in which they are of equal size in both sexes."

A form between the deciduous solid-horned and the non-deciduous hollow-horned has been pointed out by Professor Gaudry.

The position from which the horns spring is a chief point to note in antelopes, as also that the bony nuclei of the horns are hard and solid, while in the other Ruminants to be noticed they are cellular and communicate with the frontal sinuses.

It would be interesting to make an anatomical comparison between the horns of the giraffes, the rosenstock of hornless deer, the horn-stock of antelopes, and the subcutaneous osseous rudiment sometimes felt in hornless cattle, but space does not permit.

Goats.—Goats, which have been domesticated from the earliest times, occur hornless in both sexes. Jardine's description is: "Horns common to both sexes; rarely wanting in the female; in domesticated races occasionally absent in both." Describing several species of "common goat," he says, "As among the sheep, we have also a breed, white, and without horns, and here the distinction of the two forms is very close indeed, and scarcely to be distinguished, except by the hairy fleece and indication of a beard." He also describes and figures "two more grotesque-looking goats, which have been generally placed as varieties of the domestic breeds, and are represented on the next plate, taken also from the figures of Fred. Cuvier. They are the Nepaul goat and the goat of Upper Egypt. These two animals would almost seem not to be varieties, but distinct species, though, perhaps, there is not so much difference as we see in some of the races of dogs; and this is one of those points in natural history which is extremely difficult to prove, even with the most extensive menageries and most favorable situations. The most marked character in the black figure, the Nepaul goat, is its high and slender figure. The arched form of the nose, occasioned by the convexity of the nasal bones; and the long and pendulous ears, generally of a white color, or paler than the tint of the body. The other figure on the plate, the goat of Upper Egypt, is generally of a brown color, standing high, and somewhat of the form of the Nepaul goat. The hair longer and more shaggy, the bones of the nose very much raised, and the appearance of the chin and face, with the exhibition of the teeth, putting one in mind of the pugs among dogs. The ears are also ample and pendent; from the neck there is frequently hanging two fleshy tubercles, an accessory which is also sometimes seen in some breeds of sheep. In the female, the udder is always very pendent, sometimes almost touching the ground. The figures in the plate are *both* hornless.

Professor Low[1] says of the domestic goats, "Sometimes the horns disappear in one or both sexes; and in certain cases they become polycerate." Extending over the varied surface of Hindostan, the goats assume a prodigious diversity of color, aspect, and form. Sometimes they have horns, and sometimes they are destitute of horns. The Syrian goat, though so called, is not

[1] Domesticated Animals of Britain.

confined to Syria, but extended, by the countries of the Euphrates, into Arabia, and, with some slight change of characters, into Upper Egypt and Nubia. This kind of goat was known to the ancients, who mention it by the name of the Syrian, and sometimes by the Damascus goat. It is generally without horns. In Nepaul a beautiful goat is domesticated, which so much resembles the Syrian that both appear to be derived from a common stock.

Figuier states that of the common goat (*C. hircus*) "there is a subvariety without horns," and that the Syrian goat, pendulous-eared, is more frequently without horns than the common goat.

The writer of the article on Goats in the "Encyclopædia Britannica" (ninth edition), noticing the Maltese hornless variety, remarks, "but the absence of these appendages is likely a freak of nature and not the peculiar character of a particular species."

Mr. Henry Stephen Holmes Pegler, Secretary of the British Goat Society, in his well-known work, "The Book of the Goat" (1885), says,—

"A French writer, on the authority of an 'Encyclopædia of Natural History,' classifies the varieties into four distinct groups: 1. Goats with short prick ears, as the common goat, the hornless goat, and the dwarf goat of Guinea. 2. Goats with long, wide, pendulous ears, as the Syrian and Nubian, or Egyptian. 3. Goats with drooping ears and curly woolly coat, represented by the Angora. 4. Those having semi-pendulous ears and a downy undergrowth of wool, as the Cashmere. . . . As regards hornless goats, which this author places among the prick-eared varieties, it is a question whether there exists a breed without horns which may be relied on to reproduce that peculiarity without deviation. I am inclined to share the opinion of Professor Simonds, late Principal of the Royal Veterinary College, that there is no hornless race, but that the absence of the corneous appendages is purely a freak of nature apparent in all breeds, though doubtless in some more than in others, according to the fancy of a people for encouraging and perpetuating the peculiarity. At the same time, there can be no doubt but that by a careful selection, and breeding always from polled goats, a strain could be established which would produce, with tolerable certainty, hornless stock. The French writer referred to says, 'The goat without horns appears to have a rather ancient origin, for the modifications which characterize it are deeply rooted. We know in other respects but little concerning this pretty creature, whose most esteemed quality consists in the value of its flesh, which possesses but little odor, and is very good eating,

being often mistaken for mutton.' He then concludes by saying, 'The hornless goat is of Spanish origin.' Now the country where hornless goats are most common is Malta, and the close proximity of that island to Spain would lead to the inference that the Maltese is the kind here alluded to, especially as it is not mentioned elsewhere in the work. If this be so, however, the grouping is certainly at fault, seeing that the Maltese goat has decidedly pendulous ears, and cannot, therefore, be placed in the same category as the prick-eared varieties." (Pp. 18–21.)

He, on pp. 27, 28, describes "The Maltese goat" thus:

"If a really hornless breed of goats exists, it is the Maltese, there being more polled specimens among this variety, I believe, than any other. The greater proportion, indeed, are of the hornless type, and white or grayish-white in color, with brown or black spots. It is long-haired, of rather large size, with a long neck and head, the facial line being nearly straight. The ears are of considerable length and width, and as pendulous as those of a double-lopped rabbit. All the goats of this breed that I have kept myself, or seen, were thin, bony creatures, with very flat sides."

But all are unanimous in placing this variety foremost among milkers,—an important point to note.

On pp. 101–3, under the heading "Importance of Pedigree," he gives an analysis of a pedigree which he says he selected "as showing how, whilst most of the ancestors are hornless, a horned goat is produced."

In a paper by the same author in *The Live-Stock Journal Almanac* (1887), in referring again to the importance of the Record he says,—

"A perusal of this volume clearly demonstrates also what I have often stated, that the hornless, short-haired goats are far the most popular, and pay the best to breed. . . . Of course, I am aware, and admit, that there are also many equally good animals among horned goats. But hornless stock are unquestionably more in demand. Long-haired goats, on the contrary, with their correspondingly long and dangerous horns, are never popular, and very few indeed are now seen, as they are not taking in appearance."

The British Dairymen's Association, at their annual exhibition in London, has four classes for the reception of hornless varieties of goats.

Varo and Columella inform us that in their times the Romans

dishorned (as is now such a common practice in the Western States of America, among cattle) their goats and sheep of certain kinds. This would indicate that they were acquainted with the useful properties of hornless races of these Ruminants, which we, indeed, know to be the fact with the latter.

Sheep.—Generally considered sheep are described as having "horns common to both sexes, sometimes wanting in the females." The domestic breeds are, however, mostly polled.

Aristotle (4, xxvii.) states that in Libya the horned rams are born at once with horns, and not the males only, as Homer says, but all the rest also. In part of Scythia, near the Pontus, the contrary is the case, for they are born without horns.

Jardine figures a peculiar breed of Persian sheep. It is polled, with black head, ears, and neck, the rest of the body white: has pendulous ears and arched profile, stands somewhat high, and has short, crisp wool. It seems to resemble the breed of African and Ethiopian sheep. It also appears to spread itself into many varieties,—the Morocco breed, the Congo breed (covered with very loose wool instead of hair, with two wattles beneath the throat), the Guinea breed, and the Angora races (which have finer wool).

He also mentions the hornless Mysore as the most beautiful Indian breed. In Russian Tartary are polled, lop-eared, Roman-nosed sheep.

Prof. Youatt says ("Sheep"),—

"The primitive breed was certainly *horned*,[1] and those horns were of considerable size. . . . The polled sheep were probably an accidental variety, and when first occurring, cultivated partly for their singularity, and more for their utility, whether with reference to the additional closeness or folding of which they were capable, or the fewer accidents that were likely to occur, or, most of all, from the supposed docility and quietness of those to whom nature had not given these weapons of offence, and of the use of which all animals soon become too conscious. There is not, however, a polled breed of the present day in which lambs are not occasionally dropped with the rudiments of horns; some of these horns grow to their full size, and others are curiously attached to the skin alone, and either hang loosely down or drop off."

The first two figures he gives are (1) that which is common in the north and south of Asia, prevailing more than any other in

[1] Page 363 he says "*probably*" instead of "*certainly*."

Palestine, interior and north of Russia, and of which the Turcoman Kalmuck flocks, etc., principally are composed. It is fat-rumped and horned. The second cut (2), representing a ram of the Primitive Sheep, is that of the "fat-rumped polled sheep prevailing in Persia." It is the same as mentioned by Jardine. Youatt discusses whether this breed,—the fat-rumped,—which mostly prevails in Palestine, is the same with that of which the sacred historians speak? He shows that the patriarchal breed was the sheep whose fat was principally deposited, not in the tail but on the rump, or in those parts immediately connected therewith. The Persian polled sheep was the more beautiful specimen of the primitive fat-rumped breed.

"The level back and belly," says Youatt, "the rounded carcass and the light small leg would induce the easy belief that from such animal our own down and mountain sheep might have originally sprung." This is a view similar to the opinion as to the Zebu being the ancestor of our domestic races of cattle.

In describing the Egyptian, Ethiopian, and Abyssinian fat-tailed sheep, he says in Nether Ethiopia the fat-rumped variety begins again to be found of rather smaller size than the Persian. The smaller sheep, resembling, and, except in size, identical with the Persian or primitive breed, is more prevalent. The cut given on p. 23 (the polled fat-rumped Persian) represents the usual Abyssinian, but of a somewhat larger size.

Many of the sheep of East India, and particularly the Mysore closely resemble the Persian. They are without horns.

Professor Low says the polled Persian is found in Arabia, the countries of Euphrates, into Persia, whence it has been sometimes erroneously termed the Persian breed, though in no degree proper to Persia. They are found in Madagascar and along the southeastern coast of Africa, Abyssinia, and the countries of the Red Sea.

Youatt, in a note, mentions "a broad-tailed polled black ram at present in the Zoological Gardens, Regent's Park, that has floored most of his keepers, and is master over every sheep and beast in the place." This is of interest.

Columella has recorded his preference for the "hornless breed" of sheep.

Early English writers record their preference for the polled

varieties of sheep,—Markham, Sir Anthony Fitzherbert, Barnaby Googe, and W. Ellis.

Pennant divides sheep into two classes: (1) Ovis anglica—the Hornless, and (2) Ovis polyceras—the Many-Horned.

Gilbert White, writing from Ringmer, near Lewes, December 9, 1773, to Thomas Pennant, has the following on hornless sheep:

"One thing is very remarkable as to the sheep; from the westward till you get to the river Adur all the flocks have horns, and smooth white faces, and white legs, and a hornless sheep is rarely to be seen; but as soon as you pass that river eastward, and mount Beeding Hill, all the flocks at once become hornless, or, as they call them, poll-sheep; and have, moreover, black faces with a white tuft of wool on their foreheads, and speckled and spotted legs, so that you would think that the flocks of Laban were pasturing on one side of the stream, and the variegated breed of his son-in-law Jacob were cantoned along on the other. And this diversity holds good respectively on each side from the valley of Bramber and Beeding to the eastward, and westward all the length of the downs. If you talk with the shepherds on this subject, they tell you that the case has been from time immemorial, and smile at your simplicity if you ask them whether the situation of these two different breeds might not be reversed. However, an intelligent friend of mine near Chichester is determined to try the experiment; and has this autumn, at the hazard of being laughed at, introduced a parcel of black-faced hornless rams among his horned western ewes. The black-faced poll-sheep have the shortest legs and the finest wool."

John Lawrence, in 1805, gives a concise "Description of British Sheep," of which he enumerates eighteen polled races and some foreign races, as Dutch and Danish, which seemed to be varieties of the Spanish (Merino). Mr. Arthur Young, the celebrated author of "The Annals of Agriculture," wrote that "while in Spain I examined the sheep attentively. They are in general polled, but some had horns," etc.

Professor Boyd-Dawkins states, "The hornless breeds of sheep date back in our country from the days of the Romans, since the hornless skulls have been found associated with Roman remains in London." And "from the analogy of cattle it is certain that they were derived from a horned race, such as the Welsh or old Irish or Exmoor breeds. Nevertheless the horned is more abundant in the Roman refuse-heaps than the hornless, and in those days was the dominant breed."

H. von Nathusius writes me from Saxony:

"In Germany there are some polled sheep, particularly of the large, short-tailed, marsh breeds, that now mostly have been crossed with the long-woolled English. There are few of the aboriginal ovine tribes left untouched by Merino blood. Among the Merinos there is no regularity at all concerning horns. There are breeds in which almost all the ewes have small horns, and others, particularly in France, where even the rams are devoid of them. They have given them premiums, indeed, limited to hornless rams only. I some time ago bred a small flock of a cross between hornless French Mauchamp Merino[1] rams and Lincoln sheep from Lady Pigot's flock, and, strangely enough, a large percentage of the rams and an occasional ewe came with horns.

"In the collection of the University of Halle there is a very interesting suite of ovine skulls, beginning with such of the most strongly-developed horns, and consequently 'Hornzapfen,' down to the hornless tribes, where there are not any rudiments of the bony excrescence left, and finishing with skulls of the Italian Bergomask sheep, the largest breed in Europe, in which both sexes are always hornless, and in which you sometimes find in the place where the 'Hornzapfen' appear in horned sheep, a *depression in the bone.*"

In 1863 the French government introduced some of the famous *Ong ti*, or Chinese prolific sheep. The consignment was divided into three lots, one of which was sent to the Jardin d'Acclimation, where they have increased enormously. They weigh—well, as high as one hundred and fifty-four pounds; the flesh is of good quality. The wool is of mother-of-pearl brilliancy, but of common quality. The head, which is very small, is covered with short, close, and shining hair. The animal has no horns, but what gives the greatest peculiarity to the sheep is, that they have no ears. The legs are long and hairless; the body short; the chest expansive, and loin good; the tail is short and folds on itself in a crease of the skin that encloses a fat of very fine quality. The distinguishing trait of the race is its fecundity, producing from two to five twice a year. Two only are generally raised, though the mothers are excellent milkers.

[1] The male (hornless) of this breed is figured by L. Figuier.

(To be continued.)

EDITORS' TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

In most university work study and instruction naturally cease with the beginning of the long summer vacation. The broiling suns of July and August are not conducive to the study of Greek roots, or problems connected with the fourth dimension of space. With biological studies the summer is most important, for then is the time when the student, relieved from all other duties, can carry on uninterruptedly a course of study and investigation which supplements in an admirable manner the lectures, dissections, and demonstrations of the college year. As our colleges and universities are situated, it is extremely difficult to give the students, in term-time, any adequate idea of marine forms and their wonderful development,—points which are of great importance in a broad and well-balanced biological education. It is the recognition of this fact which has led to the establishment of marine laboratories along the eastern coast of the United States. In them are learned facts which could be obtained in no other way.

The importance of these laboratories or stations is recognized by every biologist, for in them a large part of the biological instruction is given, and in them a large portion of the original investigation is carried on. It is only a few years since there were none of these regularly established stations. Then the student went to some favorable spot, hired a building or a room on the shore, and conducted his researches with the most primitive apparatus, and under the most discouraging circumstances. In later years there have been various stations established, more or less permanently, and to these students have flocked from all parts of the Union. To show their importance no better example can be taken than the summer laboratory of Johns Hopkins University. This dates almost to the first year of the institution which supports it. It has constantly been conducted by Dr. W. K. Brooks at various points along the coast from the shores of the Chesapeake to the West Indies. The results it has accomplished can be seen by the various publications that have proceeded from it, and the positions now occupied by those

who have availed themselves of the facilities it affords. In amount and character of its biological work the Johns Hopkins University has but few rivals in America, and it is safe to say that at least half of its prominence and prestige in this respect is due to the work done in its marine laboratory.

There is ample evidence that there is an increasing realization of the importance of these summer schools in connection with university instruction. Anything which should tend to lessen the present number would be deplorable. There should be more of them, and more money for their support. Not all institutions have the wealth or have trustees with the breadth of view necessary for the establishment of such stations; and yet similar facilities should be enjoyed by all. In such cases the deficiency should be met either by co-operation or by hiring tables at some established laboratory. As it now is, except the Johns Hopkins Laboratory and that of the United States Fish Commission, all of these stations are supported by individual efforts. The time, however, cannot be far distant when there will be more of these laboratories which will bear an intimate relationship to our colleges and universities. When that time comes biological instruction will be of a higher character, and the biological sciences will take a higher rank in the public estimation than they now do.

RECENT LITERATURE.

Review of Dr. H. Rink's Paper on the East Greenlanders.—The following article is based on a consideration of the interesting conclusions deduced by Dr. Rink in his admirable paper on the East Greenlanders.

The first subject to be considered is the conclusion expressed concerning the original home of the Eskimo.

That Dr. Rink finds evidence tending to confirm the hypothesis that Alaska is the scene of their origin, and supports the statement in the fact that the Eskimo are not strictly confined to the littoral portions of Alaska, but on the mainland thrust themselves along the more important rivers to a greater or less distance, which is in each instance determined by the limit of trees approaching the coast, along the river-banks. Along the Kus-

[1] Die Ostgrönländer in ihrem Verhältnisse zu den übrigen Eskimostämmen. Von H. Rink. Deutsche geographische Blätter, vol. ix., No. 3, 1886, pp. 228–239.

kokvim and the Yukon Rivers a slight allowance should be made for the constant maintenance of trading-stations situated favorably to induce both the Indians, who dwell in the northern regions, strictly within tree-limits, and the Eskimo, who dwell without it, to trade at those stations.

In three localities the Alaskan Eskimo are known to disperse far into the interior. The first area to be considered is that lying between the Yukon from near the Shgeluk across to the Kuskokvim at Kolmakofsky Redubt and to the sea. This great expanse of barren ground is quite populous with Eskimo. The second and third areas are adjacent, and comprise the region lying east of Kotzebue Sound. Here are the mountain Eskimo and, to the north of them, the Eskimo along the banks of the Kuwuk and several other streams of greater or less importance. The occurrence of these people in each of those localities can certainly form no hypothesis that will tend even to support the assertion that their presence away from the coast should show their origin.

Dr. Rink submits the strange deduction that the Eskimo kaiak is a derivative of the Indian birch-bark canoe. From the earliest accounts every particle of reliable information proves that the most deadly hatred and animosity existed between the Indians and Eskimo wherever they came in contact. Their earlier history is filled with traditions of scarcely credible atrocities practised by each people upon the other; and any one who believes the possibility of the birch-bark canoe being adopted as a model by the Eskimo for his skin canoe has but little knowledge of the contempt of the Eskimo for anything of Indian construction.

Just why the word *umiak* was not substituted and that model considered instead of the birch-bark canoe is incomprehensible. That the umiak is the original of the kaiak is proved by the tradition now existing among the people of Attu, the westernmost island of the Aleutian Chain, and where the writer lived for eleven months.

The narrative is, in substance, as follows: We always had the umiak as a boat for general purposes, used as a vessel for a community or several families. Later, when strife became common, the umiak was made smaller, and only a man and his own family entered it and made it their home for days at a time. They were thus exposed to the inclemency of the weather, and a cover was made over the front as a protection for the family. The place of the man was now drawn nearer the centre, and that left space behind in which could be stored the effects that also required protection. By the act of covering at each end a small space was finally left in which the man could sit, and it was then found that the accompanying members of the family were unnecessary to comfort and speed.

A shaman, who had attained a degree of reverence from his

people and whose decree was law, decided that the women and children should no longer accompany the man in the covered boat, and that the length of the vessel should be that of the fin of the large whale; hence the development of the kaiak, which is essentially a vehicle employed by the men, and not by women and children.

That the kaiak reaches a higher stage of perfection in certain localities depends upon the environment and the means at hand. The clumsiest kaiaks are doubtless those of the region lying between the south side of the Yukon Delta and south to Cape Newenham, on the north shore of Bristol Bay, Alaska. Here the struggle for existence precluded the possibility of devoting time and mental labor in evolving such a craft as is to be found on the shores of Kotzebue Sound and in the perfection of the Greenlander's skin-canoe.

The various patterns of construction, as shown by a cross-section of the kaiaks from several localities, indicate that the form is adapted as much to the particular local wants as, perhaps, to the mental scale of the people of each region. The scarcity or the abundance of material for construction of the framework has evidently had nothing to do with the degree of perfection attained, for at the mouth of the Kuskokvim River an unlimited supply of wood may be obtained, while on the west shore of Baffin's Strait or on the shores of Greenland the supply of wood is necessarily limited from the condition of the position.

Traders in Alaska never employ a birch-bark canoe when undertaking a journey, except it be far inland, where if a three-holed kaiak were used and became damaged or worn it could not be repaired for the lack of material (skin) and a knowledge how to perform the work upon a skin-canoe. At all of the lower stations where seal-skin is obtainable the kaiak of three holes is employed exclusively, and never the birch-bark canoe. It is rare indeed to find a two-holed kaiak on the mainland waters. Many writers, however, contend that the two-holed kaiak is of prehistoric origin. Such statements are not warranted by facts presented.

The two-holed and the three-holed kaiaks are of Russian invention, and are used only in the sea-otter regions of Alaska or where the sea-otter formerly ranged. The construction of the two-holed kaiak was due to the Russian promish leniks, or, as there intended to mean, the leaders of a hunting-party, who had need for as many men and as few kaiaks as possible when waging war with the neighboring people. It was not a difficult stride to evolve a two-holed kaiak from that having one hole, and after that to create one with three holes in order to accommodate some high functionary who desired to travel in state while two men propelled the affair.

It was afterwards found that so many men had been killed that

youths must be employed to take the place in the rear hole in order that the hunter could cast his dart at the sea-otter, now made doubly wary by the energetic pursuit of it from the increasing number of rival fur companies. As that creature was restricted to certain portions of Alaska, the use of the two-holed kaiak has never gone beyond those limits. The convenience of the three-holed kaiak has made it an accompaniment of the white trader wherever he has gone and been able to procure the skins with which to cover it.

The width of the umiak precluded the probability of the double-bladed paddle being thought of; hence, as the Indian seldom employs the double blade in propelling his birch-bark canoe, it is not difficult to believe that the single paddle was first used and the double blade was devised by an accidental loss of the single paddle, and that the double paddle was evolved from a stick taken from the load of fuel then being carried on the top of the kaiak, which was found to be so effective that its improvement and adoption certainly required but little mental strain.

That some of the Eskimo do not employ the double paddle is well known, and due probably as much through choice as by anything else. Let it be as it may, the art of turning over the kaiak and the occupant righting himself is a diversion practised only where the double-bladed paddle is in common use, and not by all the people using it as a means of propulsion. The Aleuts employ the double-bladed paddle exclusively, and the mainland Eskimo, with the Kadiak Innuit, employ the single blade to as far north as the upper portion of Norton Sound, where an occasional double paddle is used. As far as the mouth of the Mackenzie the single and the double blade are in use through individual or circumstantial preference. East of the latter place the double-blade paddle appears to be the one used exclusively by the Innuit wherever found.

In regard to the development of the various spears, darts, javelins, and other projectiles cast by the use of the arm and the hand-board, Dr. Rink considers them to be developments of the arrow.

The hand or arm was certainly the power to guide and cast a spear or dart long before the flexibility of wood was applied as a means to produce direct motion by the release of a shaft from a string used to create the tension of the bow, even in its crudest condition. If this be true, it is far more probable to conclude the opposite of the deduction inferred by the remarks of Dr. Rink.

If the various projectiles used as means to obtain creatures from the sea, lake, or stream are modifications of the arrow, as understood to be the missile sent from a bow, then it would appear that those weapons now recognized as arrows and everywhere used for land-shooting, except a few instances where the

hunter stands on land and sends that shaft into an object in the water, or where a particular form of arrow is used to transfix a fish while the operator stands in a boat, are the most primitive of all projectiles. It is scarcely credible that such should be the case when all probability points to the simplest form of javelin as the original, and that the arrow is a modification of that weapon.

The bird-spear with three or four divergent prongs on the forward end is certainly an older weapon than the one having that number of prongs situated or affixed near the central part of the wooden shaft. The simple shaft with a single point, or with the later-devised toggle-point, is also an old projectile. The bird-spear having the prongs near the centre of the shaft is then a combination of the original forms of the simple spear and the trident bird-spear.

This combination happily effected the purpose of two weapons in one; for if the kaiaker observed a flock of birds, the combination projectile afforded means of securing them, while if a seal or other mammal thrust its head above the surface of the water, the same instrument, with its shaft of ivory having dentate edges, could be employed to pierce its skin and result in its capture by the hunter, who in these emergencies needed but a single weapon.

It is not, however, uncommon to find the three prongs, or even four prongs, with a central shaft, which is always shorter and subordinate to the long, divergent ones, used for hand-throwing at birds or for transfixing a fish. This form is more commonly reduced in size and employed as an arrow to be projected by the use of a bow of short length, and projected while the kaiaker sits in his skin canoe. The low position of the occupant interferes, however, with the use of the bow while so sitting; hence the employment of that missile did not come into general use.

Some of the projectiles employed by the Eskimo to capture mammals, birds, and fishes have feathered vanes. The material which is used to form the head on the wooden shaft is of such nature that it will curve or distort if not kept at an even temperature. The object of the feathering at the opposite end is to obviate the rotation of the projectile and to produce certainty and steadiness of flight and prevent twisting caused by the curvature of the forward end of the shaft. In other words, the feather-vanes produce the opposite of that which the rifling of a gun is intended to effect. When an Eskimo discovers an object which will afford food or raiment he has no time to lose in nicely adjusting his missile with regard to the curve of the bone or ivory head. It will be readily understood that those weapons which are projected by the bow and the hand-board are the only ones which have feather-vanes attached to them. The feathers for the shafts employed to secure aquatic creatures are taken only from

water-fowl, while the feathers that vane the arrows used to slay land creatures are procured only from land birds. In some localities the feathers of the raven form an exception. Those projectiles which are to be cast by the hand alone never have feather-vanes attached to them, and in many localities the feathering is discarded on the shafts thrown by the hand-board.

In regard to the supposition that the custom of wearing labrets in the lip of the Eskimo is due to and derived from the Indians (Thlinkets) dwelling south of them, this is a conclusion based upon an erroneous conception of the facts in the case.

That the custom of wearing labrets, or lip-studs, is fast disappearing among the Eskimo is not a remarkable thing in itself. An almost entire revolution in customs and manners of far greater significance is not uncommon among nations or peoples farther advanced in our idea of the scale of civilization, or an approach to it. Certainly that those customs which are of least advantage would be the earlier discarded will not be denied by any one. The same remarks are well applicable to the practice of tattooing, which in the eastern regions is not at all general, and in some localities has almost disappeared; yet one of the most profusely tattooed individuals the writer ever saw was an Eskimo woman at Fort Chime, Ungava; other women there were unmarked by tattooing. This remarkable instance was due simply to the fancy of the individual performing that operation upon a subject who had no will in the matter, and for that reason should not be taken into sufficient consideration to form a theory or a generalization on. Yet how unfortunate for science if an exploring expedition had touched at a locality where this woman and her husband had happened to be the only ones of the Innuit of the region seen and she be the subject of an elaborate discussion, which a fertile mind would generalize into a universal custom!

To return to the custom of wearing the labret, or lip-stud. It seems just as probable that the practice of perforating the lip and inserting a piece of stone, bone, or ivory had its origin in the east, and that they should be the first to discard it and the western Eskimo the last to relinquish it. It is a well-recognized fact among those people that the labret seriously interferes with the chewing of tobacco, for the stud must be removed, and this permits the saliva to flow from the orifice. This flow freezes in winter and results disastrously to the person. Hence the love of ornamentation has been subordinated to the gratification of an acquired habit of a character originating but recently. The very abruptness in the Mackenzie region of wearing the lip-stud tends to prove that the lack of intercommunication between the widely-separated people termed Eskimo has served to perpetuate the custom to the westward.

That the Thlinket should originate a custom now adopted by

the western Eskimo is scarcely borne out by a consideration of other facts that may be adduced to prove the contrary. The form and position of the Thlinket lip-stud is not copied by any of the Innuit. The latter perforate the lip directly under the corner of the mouth, while the former pierce the median line of the lower lip.

All of the traditions, legends, and speech of the western Innuit point to an eastern origin, and that the route lay by the sea and northern land. Their extension southward was partly a matter of choice and as much so of necessity. When they came in contact with the Thlinket and ceased their wandering, why should not the Thlinket as a propitiatory measure have adopted a custom of the Innuit, but modify the position and form as well as go only half-way and wear but one lip-stud?

In regard to the material of construction, form of the dwellings, and the disposition of the fireplace, Dr. Rink advances some arguments which should be taken into consideration.

A tradition exists among the Unalit of Norton Sound to the effect that the ancestors of the present people constructed dwellings of sod, earth, and stones, when each of those materials was at hand. Now the greater portion of the western Eskimo dwell in fixed habitations composed of logs set on end or laid one above the other to a sufficient height and banked nearly to the eaves with dirt. The convenience of the material employed is evident; hence the transition from the former character of dwelling to that of the present needs no discussion. The position of the fireplace in their present habitations is that tending to an economy of space and for the convenience of the occupants. The light-hole, which forms also the place of exit for the smoke of the fire within, is placed in the centre of the roof, so that the rays of light may diffuse themselves equally on all sides of the room within, while if the fire were built at one side the smoke-hole would be placed directly over it, and this would tend to cause crowding around that particular portion in order to obtain the advantage of the most light in the short days of the long winter.

The form of the house is consistent with the character of the material used in its construction. Rough-laid stones without cement or mortar would tend to fall if arranged in walls to form a square or oblong; but if the arrangement be circular or dome-shaped, then the pressure would be equal on all parts; and where the material is of sufficient firmness to withstand a crushing strain, the best adapted form is that of the dome.

The common snow hut of the eastern and northernmost Innuit is constructed on that principle, for the simple reason that no other form would support the weight. This shape tends to prevent additions or intercommunicable chambers, except of a less specialized character; and not until the use of wood was

adopted do we find that several chambers or dwellings are so placed as to cluster on at least three sides about the original structure, which insures by this arrangement additional protection and proximity. There are many facts to adduce in support of the clustering character of the dwellings, but as they involve so many considerations, a discussion of them will be deferred for another occasion.

Where wood is scarce and large pieces are met with but few times in the course of an Eskimo's life, those few large pieces are reserved to furnish him with props or supports for his tent in summer, or for the frame of his umiak, or the shafts of his spears and other necessities, which are greater to him than fuel to cook his food or to make warmth. There the turf or stone-walled hut is the kind of dwelling, while the snow hut is from its nature a winter edifice only.

The Eskimo of Southern and Western Alaska know of the snow hut only by tradition. Only in the extreme northern part of Alaska do we begin to find the snow-blocks employed as material from which to construct a dwelling; thence eastward the use of that substance is common as far as the Eskimo extend.

None of the Eskimo south of Hudson Strait erect permanent dwellings for themselves, with the exception of those directly and continually in contact with the white people (missionaries) of Labrador. The only shelters are the skin tent and the snow hut. In many places there are traces of former habitations of stone and turf; the two materials having been apparently combined, for the disposition of the ruins indicates an insufficient quantity of either material by itself. Instead of the huge *kazhgŭk*, or "club-house," of the western Innuit, a large, oblong space is walled with blocks of snow, and within the inclosure repair those who participate in the festivals and dances commemorative of the return of the sun from the south. At the same season the practice of distributing presents to the living in honor of the dead also takes place; but as this latter ceremony occurs only every fourth year in any locality, the honoring of the dead and change of names is held previous to the dances, in propitiation of the light-giving principle.

A discussion of the linguistic affinities and the correlation of the myths, legends, traditions, and beliefs, which go far in the character of the Innuit, will be deferred for a separate article.

To Dr. Rink the legion of ethnologists cannot fail to express their admiration of his description of research and the practical advantages to be gained therefrom; and it is earnestly hoped that the publication of the entire results of the recent expedition to the locality of the East Greenlanders will not be long delayed.
—*L. M. Turner, Smithsonian Institution*, April 11, 1887.

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GENERAL NOTES.

GEOLOGY AND PALÆONTOLOGY.

On the Glacial Flow in Iowa.—There is evidence of at least three ice-flows, or advances, of the glacial sheet in Iowa:

First, from the northeast; second, from the northwest, as recognized by Dr. C. A. White;[1] and, third, from the north.[2] The evidences of these flows are found in the striated rocks, the transported materials, and the moraines.

The first glacial flow, so far as we have present record of it, was from the northeast to the southwest. Native copper and iron ore have been found in the drift in the extreme northern as well as the extreme southern part of the State, in irregular lumps of a few ounces or a few pounds in weight.

One lump of iron ore, found by E. W. Jacobs, Esq., in the drift in the northern part of Cerro Gordo County, weighed slightly over six pounds, while lumps of copper from the drift of the western part of Floyd County weighed from three ounces to as many pounds. One lump of copper found in Lucas County weighed upward of thirty pounds; and specimens much smaller have been found in other portions of the State.

These specimens are, in all respects, like the native copper and iron ore from the mines in the Lake Superior region; and hence, as Dr. White observes, they were probably derived from this region.

"On account of the friable nature of a considerable part of the rocks of Iowa, or the facility with which they have become disintegrated, the grooves and the scratches of the glacier which were once doubtless abundant upon them have, to a considerable extent, become obliterated."[4] "For this reason, together with the fact that the drift so generally and deeply covers those surfaces which probably yet preserve such traces, we very seldom have an opportunity to observe them in Iowa."[4]

Nevertheless, the surface of the upper carboniferous limestone on the west side of the Missouri River, opposite Council Bluffs, shows glacial scratches having a direction south, 41° west.[5] These facts seem to imply the existence of a glacial current or flow, during some part of the glacial period, having a southwesterly direction.

[1] White's Geology of Iowa, p. 91.

[2] So far as we have knowledge of, at the present time, this seems to have been the chronological order of the ice-flows within the borders of this State.

[3] White's Geology of Iowa, p. 96. [4] Ibid., p. 93. [5] Ibid., p. 94.

The second glacial current was from the northwest to the southeast. We appear to have sufficient evidence of its direction in the glacial scored rocks, and the boulders found in the drift in different portions of the State.

The direction of the striæ observed upon the Burlington limestone, near Burlington, in the extreme southeastern portion of the State, was south, 22° east.[1]

Up to last year, this was the only locality known in Iowa where the rock surface still preserved unmistakable evidence of a southeasterly flow of the ice. But in September last, while making examinations of the Devonian limestone in the west bank of the Iowa River, at Iowa City, evidence of glacial action was observed, and upon removing the incumbent drift and loess, the surface of the rock was found to be most beautifully planed and scored by glacial action. The size of this surface was ten feet by sixteen feet, and the parallel striæ have the direction south, 73° east. Near the centre of this surface[2] one large groove was about ten feet in length and four feet in average width. As much of this rock has been removed in quarrying, it is impossible to ascertain the exact original extent of this groove. It has a depth, on the south side, of eighteen inches, while the bottom slopes gradually upward to the north; and what is of peculiar interest is the fact that the bottom, and particularly the north side, is beautifully smoothed and striated, while the south side, which is very abrupt, shows scarcely a trace of the smoothing and striating action of the ice. The trend of this groove is north, 69° east. The north side of the groove presents several distinct sets of striæ, the bearings of two of the more prominent of which were taken, with the following results:

First, north, 36½° east; second, north, 40° east, with a slope of 13½° upward. This groove was formed by a portion of the ice which seems to have been deflected from its normal course at this point.

About one hundred and forty yards south of this another surface was uncovered which presented seven or eight distinct sets of striæ. The bearings of five of the principal sets of striæ were taken, with the following results:

No. 1, south, 60° east.
No. 2, south, 85½° east.
No. 3, north, 83½° east.
No. 4, south, 80½° east.
No. 5, north, 71½° east.

The great variation in the direction of the striæ at this point is believed to have been caused by a deflection of the relatively thin ice from its normal course by some local obstruction.

[1] White's Geological Survey of Iowa, p. 94. In these cases no allowance is made for magnetic variation.

[2] The surface is from thirty to forty feet above the water in the Iowa River.

Fifty feet to the south of the above the rock presents an equally beautiful scored surface, having, however, but one set of striæ, with a direction south, 70° east.[1]

In the drift which immediately overlies the rock at this place a boulder of red Sioux quartzite, weighing about one hundred pounds, was found; and on the opposite side of the river another of the same material somewhat larger. Large boulders of the same material have also been found in considerable abundance in the drift for a distance of fifteen miles north from this locality. These boulders are in all respects identical, lithologically, with the red Sioux quartzite exposed in the extreme northwestern corner of the State, and were, without doubt, derived from that region. This evidence, together with the fact that the red Sioux quartzite boulders are found in greater or less abundance in both the western and southern portions of the State,[2] seems conclusive evidence that the ice-flow, at this period of the glacial epoch, had a more easterly direction than has been heretofore supposed.

The evidence of the third, or last, advance of the ice-sheet in Iowa is found in the moraines, which extend nearly across the western portion of the State from north to south. "These may be described as two great loops, one within the other, and with nearly parallel sides."[3]

The *outer moraine* may be approximately located as follows: Beginning a little west of the north line of Osceola County, in the north part of the State, it extends first eastward to Spirit Lake, in the northeast part of Dickinson County; thence south, curving around east of the Little Sioux River, to Storm Lake, in Buena Vista County; thence in a general southeasterly direction to near the northeast corner of Guthrie County; "thence along the Middle and South Raccoon into the north part of Madison County;"[3] thence curving to the east and northeast, "entering Jasper County;" thence to the north, which course is pursued until Clear Lake, in the west part of Cerro Gordo County, is reached; thence to the northeast, cutting across the northwest portion of Worth County, and entering Freeborn County, Minnesota, about midway between its east and west lines.

The *inner moraine* enters Iowa from the northwest, slightly west of Spirit Lake. It passes southeast with, and parallel to, the outer moraine into the western part of Palo Alto County, but instead of curving to the west from that point and continuing parallel with the former, it pursues a southeasterly course

[1] In all the above bearings an allowance of seven degrees is made for the variation of the magnetic needle.

[2] White's Geological Survey of Iowa, vol. i. p. 91.

[3] Prof. J. E. Todd, Iowa Hort. Rept., vol. xviii.

through Pocahontas and Webster Counties to the northwest corner of Boone County; thence eastward to the north-central portion of Story County; thence north into southwest Franklin County, and from that point to the northwest through Wright and Hancock Counties to Forest City, in the southeast part of Winnebago County; thence to the northwest to the northeast corner of Kossuth County; thence curving to the southeast, "forming an interlobular portion to the east side of Winnebago County;"[1] thence uniting with the *outer* moraine, as it cuts across the northwest portion of Worth County, and enters Freeborn County, Minnesota.

"These moraines are linear bends of knobby drift, and structurally are developments of the till, having similar features with it, except that their altitudes are exaggerated."[1] They were formed by an extension or "finger" of the main mass of ice at the north; the one which formed the outer moraine reached a point some distance south of Des Moines, but there stopped in its course by the action of the warm south winds and the sun, which soon caused it to retreat to the north, beyond the limits of the State; but only to again advance at a colder period, but this time with diminished volume, and to be soon driven back again by the winds and the sun.

By the second advance of the ice-sheet the inner moraine was formed.

An extended study of the drift and loess formations of the entire State would doubtless throw much additional light upon the evidence of the ice-flows and the condition of things within the borders of the State during and at the close of the glacial epoch.—*Clement L. Webster, State University, Iowa.*

MINERALOGY AND PETROGRAPHY.[2]

Petrographical News.—Very recently Professor Judd[3] has undertaken to show that his schillerization theory[4] is founded upon well-known facts. In addition to the planes of least cohesion (cleavage planes) and the gliding planes, there is a third series of planes in crystals,—the solution planes, along which the solution of the crystal takes place most readily. These are distinct from either the cleavage or the gliding planes, and their position in the crystal is dependent upon its symmetry. When a crystal fragment is subjected to the action of a solvent, solution begins along these planes, little irregular-shaped hollows appear, and as these grow larger they assume the form of negative crystals. These hollows gradually become filled with secondary substances, and in this way arise the inclusions, which

[1] Prof. J. E. Todd, Iowa Hort. Rept., vol. xviii.
[2] Edited by Dr. W. S. Bayley, Madison, Wisconsin.
[3] American Naturalist, Dec. 1885, p. 1216.
[4] Geological Magazine, vii., Dec. 1886, p. 81.

produce the peculiar schimmer on faces of the crystal parallel to the planes along which the inclusions are arranged,—*i.e.*, the solution planes. After showing that secondary solution planes may be produced in directions parallel to directions of pressure, as in the case of a faulted quartzite pebble, and that the repeated twinning of a mineral may also give rise to them, the author describes various stages in the process of schillerization, as seen in thin sections under the microscope. This theory is not intended to apply to all cases of inclusions arranged in definite planes in minerals, but only to those which at the same time show some indication of regularity of form, as in Labradorite, hypersthene, etc.——On the road between Verrex and St. Vincent, in the Val d'Aoste, Professor Bonney[1] has found a schistose glaucophane-eclogite interbedded with quartz-mica schists, limestone, and green schists. The rock consists of pale wine-red garnets, with inclusions of hornblende, glaucophane, and dust, a green hornblende, glaucophane both in irregular grains and in well-developed crystals, epidote, mica, and sphene (leucoxene). In this connection the author describes in some detail the glaucophane-gabbro of Pegli, near Genoa. This rock was described by Williams[2] as an amphibolite, but Bonney prefers calling it gabbro. The glaucophane appears to have been secondarily derived from diallage.——Specimens of kaolinized granite from St. Austell, Cornwall, indicate to F. H. Butler the close association of tourmaline with the progress of the alteration in the original granite.——According to Professor Bonney,[3] the Ranenthal serpentine is not the result of the alteration of amphibolite, as was supposed by Weigand,[4] but has been derived from an olivine-hornblende rock resembling certain pircrites. To this view Mr. Teall takes exception. He states[5] that his examination of the rock confirms the deductions of Weigand, and that the serpentine is the product of the alteration of hornblende.——The elastic sandstone of Delhi, Germany, according to O. Mügge,[6] is composed of quartz grains intricately interlocking, and a very little interstitial clayey material. Most of the cement has been removed by the action of percolating waters, and in the interstices thus left the individual quartz grains have grown by the addition of silica in crystallographic continuity with the substance of the original grains. This growth, however, ceased before the occupancy of the entire space. It is to the abundance of these cells that the sandstone owes its elasticity.——Gorman mentions the occurrence of phillipsite, chabasite, and apophyllite in the vacuoles of the basal-

[1] Geological Magazine, vii., July, 1886, p. 1.
[2] Neues Jahrb. f. Min., 1882, ii. p. 201.
[3] Geol. Magazine, Feb. 1887, p. 65.
[4] Min. u. Petrog. Mitth., 1875, p. 175.
[5] Geol. Magazine, March, 1887, p. 137.
[6] Neues Jahrb. f. Min., 1887, i. p. 195.

of Prudelles, Puy-de-Dôme.[1]——A mica-gneiss similar to the granulite of Törnebohm is described by Sjögren[2] as occurring in the iron regions of the Banat. Sjögren finds that the ores are not connected genetically with the intrusion of banatite, as has heretofore been supposed.——In his geological sketch of part of the Galician-Hungarian East Carpathians Dr. H. Zapalowicz[3] gives a few notes on the schists and intrusive rocks occurring in the more mountainous regions of the Carpathians.

Mineralogical News.—*Stüvenite* is the name proposed by Darapsky[4] for a mineral from the Alcaparroso Mine, near Copiapó, in Chile. Its analysis yielded:

So_3	Al_2O_3	MgO	Na_2O	K_2O	H_2O
36.1	11.6	1 0	2.7	trace	47.6

This corresponds to a composition represented by the formula $(\frac{1}{2}Na_2\frac{1}{2}Mg)So_4 + Al_2(So_4)_3 + 24H_2O$. The mineral occurs in acicular crystals grouped in radial masses. Before the blowpipe it presents the features of the alums, to which group of minerals the new substance probably belongs.——In the same paper in which stüvenite is described Darapsky records the results of the analyses of a large number of Chilian alums, principally of the feathery variety, and gives a list of all the alums investigated up to the present time. These he divides (following Dana) into the regular alums and the halotrichites, to which subdivision the above-noted stüvenite belongs. The names of seventeen distinct minerals are included in the list.——Hintze[5] proposes *arsenolamprite* as the name for Chilian arsenic, which possesses physical properties different from those of ordinary arsenic. The composition of the mineral is:

As	Fe	SiO_2	
98.20	0.96	0.30	(Mean of two analyses).

Specific gravity equals 5.50. It is soft, and of a brilliant metallic lustre. It is probably identical with the arsenglanz of Breithaupt, from Marienberg, in Saxony.——In 1881 Luedecke attempted to show that *mesolite*, *natrolite*, and *scolecite* form an isomorphous-trimorphous group, the first mineral crystallizing in the orthorhombic, monoclinic, and triclinic systems, natrolite in the orthorhombic and monoclinic, and scolecite in the monoclinic and triclinic systems. C. Schmidt[6] recently having the opportunity to reinvestigate the crystallography of scolecite, declares that this mineral crystallizes only in the monoclinic system, and that the triclinic variety described by Luedecke was

[1] Comptes Rendus, civ. p. 719.
[2] Jahrb. d. k. k. geol. Reichsaust, 1886, p. 607.
[3] Ib., p. 361.
[4] Neues Jahrb. f. Min., 1887, i. p. 125.
[5] Zeits. f. Kryst., xi. p. 607. [6] Ib., p. 587.

probably merely a monoclinic twin, whose twinning plane is the clinopinacoid. Since Rammelsberg[1] has shown that the orthorhombic mesolite (galactite) is probably natrolite, and since this mineral is found only in orthorhombic crystals, there has as yet been no proof given to show that either of the three minerals mentioned crystallizes in more than one system.——A. Becker[2] has analyzed *alstonite* and *barytocalcite* from Alston Moor, in order to decide as to whether Groth's view in regard to the composition of these substances is well founded. Both minerals are carbonates of calcium and barium, alstonite crystallizing in the orthorhombic system, and barytocalcite in the monoclinic. From the fact that calcium carbonate has never been found in monoclinic crystals, whereas, on the other hand, an orthorhombic variety is well known, Groth supposed that alstonite is an isomorphous mixture of the carbonates of barium and calcium, while barytocalcite is a molecular compound of the formula $BaCa(Co_3)_2$. Becker's results indicate the truth of this supposition. The composition of alstonite may be represented by $BaCa(Co_3)_2$; that of barytocalcite by $\times BaCo_3 + \gamma CaCo_3$.—— In the ruins of old mines in the neighborhood of the Windgälle, in Canton Uri, Switzerland, are found oolitic masses composed of a brown or green substance in little elliptical and lenticular grains cemented together by carbonate of lime. These little grains are themselves made up of scaly magnetite and a bright-green, weakly-dichroic mineral,[3] with aggregate polarization. This was separated by Thoulet's solution, freed as perfectly as possible from the associated carbonate, and subjected to analysis, with the following result:

SiO_2	Al_2O_3	FeO	MgO	H_2O
25.23	19.97	37.51	4.39	12.90

Upon comparison of these figures with those found by Bovicky for the *chamoisite* from Chrustenic, in Bohemia, the two minerals were found to be almost identical in composition, after allowing for the impurities in the Chrustenic mineral. Chamoisite is thus shown to be the alumina-rich and ferric-iron-free member of the series to which cronstedtite and thuringite belong.——R. Sharizen[4] has studied the physical properties of *monazite* from a pegmatitic granite-vein near Schültenhofen, in the Böhmerwald. He finds it to crystallize in the monoclinic system, with an axial ratio 0.9735 : 1 : 0.9254. The inclination of the $\dot{a}$ to the $\dot{c}$ axis is 103° 37′. The plane of the optical axes is perpendicular to the clinopinacoid, and the acute bisectrix, which is positive, is in the obtuse angle β, and is inclined 5° 54′ to the vertical axis. The optical angle $VV = 12° 44'$ for yellow light, and the indices of refraction $\beta = 1.9465$ and $\gamma = 1.9285$.——The ferric sulphate

[1] Mineralchemie, ii., Aufl. 2, p. 633.
[2] Zeits. f. Kryst., xii. p. 222.
[3] C. Schmidt, ib., xi. p. 597.
[4] Zeits. f. Kryst., xii. p. 253.

botryogen, from Fahlun, in Sweden, has been examined by Hockauf.[1] The mean of two analyses yielded:

So_3	Fe_2O_3	FeO	MnO	CaO	MgO	H_2O
36.94	16.38	2.23	1.93	0.90	7.63	33.99,

corresponding to the formula $FeSo_4 + [Fe_2(So_4)_3 + (FeO)_2So_4]$. The botryogen of commerce was also analyzed, and found not to have the composition of the genuine mineral.

Crystallographic News.—In an article on hemimorphic pyrargyrite twins from Andreasberg, Schuster[2] discusses the classification of twinned crystals, and defines them as symmetrical or unsymmetrical. The symmetrical ones he subdivides into those hemitropically developed and those which show no hemitropism. The hemitropic symmetrical twins include those of holohedral and of certain hemihedral and hemimorphic minerals. The unsymmetrical and the non-hemitropic symmetrical classes embrace the twins of those minerals which crystallize in the inclined and trapezohedral-hemihedral divisions of the different systems, and also certain hemimorphic minerals. Examples are cited to show the application of the terms of this classification to the description of complicated twins.——As the result of new investigations with the Bertrand[3] microscope and lenses, Des Cloizeaux[4] finds that the mineral which bears his name crystallizes in the orthorhombic system.——Cathrein[5] describes crystals of orthoclase in the pores of granite at Predazzo, which have their largest development in the direction of their *à* axis.——The same author mentions twinning striations parallel to the octahedral edges of magnetite from Fürtschlagl, in the Zillerthal.

Miscellaneous.—J. Lehmann[6] explains the perthitic structure of certain of the feldspars by supposing that one of the minerals, as albite in perthite, is secondary, and fills cracks in the other. The cracks he further supposes to be occasioned by contraction in the original mineral, in consequence of sudden cooling, etc. He shows, by experimenting on a large number of different minerals, that this cracking takes place, under certain conditions, not in the direction of the cleavage, but in some other direction,—usually at right angles to the most perfect of all the cleavages. In the case of orthoclase, in which the cleavages are parallel to $\infty P\bar{\infty}$ and oP, the cracking takes place parallel to $\infty P\infty$. After formation in this manner the cracks are enlarged by the action of solvents and the secondary substance is deposited in them. ——The indices of refraction for topaz from the Urals, anglesite from Monte Poni, in Italy, sphalerite from Spain, and harstigite from Pajsberg have been recalculated by Ramsay,[7] from data

[1] Zeits. f. Kryst., xii. p. 240. [2] Ib., p. 117.
[3] Bull. d. l. Soc. Min. de France, 1885, pp. 29, 377, and 426.
[4] Zeits. f. Kryst., xii. p. 178. [5] Ib., xii. p. 34. [6] Ib., xi. p. 608. [7] Ib., xii. p. 209.

furnished by the method in which prisms with large refractive angles are used. The method consists essentially in determining the refractive index of a mineral prism enclosed in a highly-refractive medium.——A few years ago Pfaff found that certain regular and uniaxial minerals possessed interfacial angles, which differed from their calculated values by some few minutes. He ascribed this irregularity to the tension producing optical anomalies, but did not show that the crystals measured were optically anomalous.——Brauns[1] has measured isotropic and doubly-refracting lead-nitrate, spinel, and ammonium-alum. He compares the deviations from the true values of the interfacial angles of the isotropic varieties with the deviations noted in the cases of the doubly-refracting varieties, and arrives at the conclusion that a difference between the angles of singly- and doubly-refracting regular crystals does not exist.

BOTANY.[2]

The National Herbarium.—The botanists of the country have for some years shown an increasing interest in the botanical work of the Department of Agriculture at Washington. This interest has, without question, been of great benefit to the Department, and has probably been the chief factor in calling into existence the "Division of Botany." The Botanical Club of the American Association for the Advancement of Science has doubtless been one of the agents in developing this interest and directing it into useful and effective channels. This work of the club, if it accomplished nothing more, would fully justify its existence.

Now, let the botanists continue their efforts for the advancement of the botanical work in Washington. Let there be a demand for adequate provision for the increase of the Herbarium. There should be an ample appropriation for the investigation and collection of plants in little-known or little-visited localities. It is well known that the Herbarium is wanting in many things which can be obtained only by sending men into the field commissioned to secure certain material. The intelligent and liberal policy of the authorities in respect to the entomological work of the Department, whereby local entomologists in different parts of the country have been set to work for the benefit of the "Division of Entomology," should be imitated on the botanical side. There are many excellent collectors who might be detailed each season to thoroughly explore certain localities at comparatively little expense, while the results would be of vast benefit to the botany of the country.

Some such plan as this must be adopted if anything at all is to be done for botany. The government surveys appear to have

[1] Neues Jahrb. f. Min., 1887, i. p. 138.
[2] Edited by Prof. CHARLES E. BESSEY, Lincoln, Nebraska.

ceased entirely even the little attention they formerly bestowed upon the plants of the country. Unless the botanists can secure some aid for the Herbarium, systematic botany will suffer grievously in the national capital. While the government is doing so much for science in geological, mineralogical, and anthropological explorations, ought it not to foster also the science of botany, which for its own sake may make equal demands with other sciences, but which may also make special demands because of its close relation to the agricultural interests of the country at large?—*Charles E. Bessey.*

A Duty of Botanists.—Every botanical teacher has in his classes some young men and women who have the desire to become botanists. The number is doubtless relatively small, the great majority in every class taking but a transient interest in botanical science; but as it is from this small number that the working-force of the botanists of the future is to be recruited, these embryo botanists should receive especial attention from teachers.

What should be the preparation of the young man or woman who proposes to enter the field of botany? An examination of a great many college-catalogues shows that in many places there are vague ideas indeed as to what preliminary or supplementary training a botanist should have. In some colleges one might suppose that those in authority imagined botany to be bounded by and included within the ordinary little text-books used in the class-room. I have in mind now some colleges where (as advertised in their catalogues) particular attention is given to botany, and where there are "post-graduate courses of study," leading to the Master's Degree, in which there is no hint whatever that the literature of botany is not all to be found in English books. Not a word of German, no French, no Latin, is indicated as necessary for the young people who pursue even the "post-graduate courses" in botany. Let not the botanists in the better-ordered colleges say that such cases are exceptional. They are not exceptional, as may be easily demonstrated by any one who will take the trouble to examine the catalogues of a considerable number of colleges.

What can a young man do in any department of botany who cannot read German, French, and Latin? The literature of Vegetable Anatomy and Physiology can only be known to him in the meagre translations of men fortunately better trained than himself, while the mass of the literature of systematic botany must forever remain sealed to him, for in this part of the field there are no translations of the great books. What will such a badly-equipped man do with Bentham and Hooker's "Genera Plantarum," DeCandolle's "Prodromus," Walper's "Repertorium," Müller's "Annales," DeCandolle's "Monographiæ Phan-

erogamarum," etc., etc.? Or, suppose he is a student in one of the agricultural colleges, what more fitting subject for him than the thorough study of the grasses, or the injurious fungi? But what can he do in the first case without the ability to use Stendel's "Synopsis Plantarum Graminarum," the works of Kunth, Trinius, Nees, Häckel, or, in the second case, the works of Fries, Persoon, Rabenhorst, Winter, etc.?

There are other grave faults in most of the courses of study in which young botanists are supposed to be getting their training, but this fault of inadequate language preparation is the one perhaps most easily remedied. Should not every teacher of botany use every means possible to bring about a change for the better in this particular? Should not every young botanist be trained in at least the three languages I have mentioned,—German, French, Latin? And is it not the duty of the teachers of botany to see to it that their colleges make provision for such training? Where the authorities will not make such provision, is it not the duty of the teacher of botany to candidly advise the young botanist to go to some other college where necessary preliminary training is not ignored?—*Charles E. Bessey.*

The Element of Time in Botanical Study.—In the arrangement of courses of study it should be borne in mind that the beginner in botany requires more time than is usually allotted to the subject of elementary botany. In fact, it may be said that more time is necessary for botany of any kind or grade than is given to it in ordinary courses of study. In most cases, still, botany occurs as a daily study in the spring term of some school year, often the freshman year in colleges, and this dose (for such it is) is, in many instances, repeated a year or two later. In high schools it is rarely the case that botany receives more time than is afforded by a single spring term.

Now, it must be remembered that botany is a science of observation, and that botanical study on the part of the pupil must consist largely of training and practice in the observation of plants. Nowadays but few teachers are willing to teach botany as a text-book study alone. The pupil is expected to learn about plants by the study and observation of plants rather than by the conning of books. But learning to observe is slow work. One cannot become an observer by simply being told to observe; nor can he become a close observer by a few weeks' hurried practice. A good deal of time is required. The pupil's faculties must have time in which to grow. Just as the learner must have time, extended time, in which to acquire facility in the use of his fingers in performing upon a piano, so he must have time in which to learn to use his eyes in botanical science.

Let our teachers, wherever possible, extend the time devoted to elementary botany so that it will reach through a school year.

Where it is not possible to devote more school time to this science, let the teacher arrange for a year's course with but one or two exercises each week. A pupil who devotes two exercises each week throughout one school year to botany will at the end of that time have a much better and far more enduring knowledge of the subject than if he had devoted five exercises each week to it for a single term. Properly managed, even one exercise each week for a year will bring better results than five exercises a week for one term. Two exercises each week in the fall term, one each week in the winter term, and two a week in the spring term is an arrangement which I have found to work excellently in practice.—*Charles E. Bessey.*

Botanical News.—Sereno Watson's contributions to American Botany, XIV., in the *Proceedings of the American Academy of Arts and Sciences*, vol. xxii. (pp. 396 to 481), consist of (1) a list of plants collected by Dr. Edward Palmer in the State of Jalisco, Mexico, in 1886, and (2) descriptions of some new species of plants. Among the interesting new things are two species of Begonia, one of Zinnia, two of Ipomœa, two of Salvia, five of Aristolochia, two of Habenaria, three ferns (Acrostichum, Notholæna, and Cheilanthes), and three species of Erythronium, the latter from Oregon. Three new genera are described,—viz., Mellichampia (*Asclepiadaceæ*), Prochuyanthes (*Agaveæ*), and Podistera (*Umbelliferæ*). The determinations of the Gamopetalæ and the descriptions and notes upon them are by Dr. Gray, the Juncaceæ and Cyperaceæ by Dr. Britton, the Gramineæ by Dr. Vasey, and the Filices by Professor Eaton.——"A Revision of the North American Linaceæ," by Dr. William Trelease, in *Trans. of the St. Louis Academy of Science*, vol. v. pp. 7 to 20, includes an arrangement and description of all our species of Linum, twenty-one in all. The paper is a welcome addition to the literature of systematic botany.——Thomas Meehan has recently read short papers before the Academy of Natural Sciences of Philadelphia upon the following subjects,—viz., "On the Interdependence of Plants," "On Petiolar Glands in some Onagraceæ," "Sugar in China," "Floral Calendars," and "Cortical Peculiarities in the Plum."——Professor T. C. Porter has just published (in *Proc. Acad. Nat. Sci. Phil.*) a valuable "List of the Carices of Pennsylvania."——Part 2 of *Pittonia* has come to hand. It contains much interesting matter, and has a delightful flavor of individuality and originality. The articles of most general interest are those describing the flora of San Miguel, a small island fifty miles west of Santa Barbara.——By the time this number of the NATURALIST reaches its readers the long-promised "Fresh-Water Algæ of the United States," by Rev. Francis Wolle, will be ready for distribution. It will appear in two volumes, the first consisting of three hundred and sixty-four

pages of text, giving descriptions of species, a glossary, and indices; the second volume contains one hundred and fifty-seven plates, representing over two thousand colored figures. The whole work embraces nearly thirteen hundred species. The price (ten dollars) is remarkably low, when we consider the expensiveness of the colored plates. The work may be obtained of the author at Bethlehem, Pa.

ENTOMOLOGY.[1]

Singular Adaptation in Nest-Making by an Ant, Cremastogaster lineolata[2] Say.—A month ago I received an ant's nest, sent by Assistant Engineer Henry A. Brown to General W. G. Lewis, of Goldsboro', N. C. The nest was built several feet from the ground on a bush, in the marshes bordering Broad Creek, Hyde County, N. C.

This ant usually nests "under stones or underneath and within the decayed matter of old logs and stumps. This material is sometimes prepared by the ant as a paper-like pulp, and arranged into cells and chambers, which are attached to the surface of the logs."[3]

This nest is about eighteen inches long by twelve inches in circumference at greatest diameter. I made a longitudinal section of it, and had a photograph taken, so as to represent both the external form and internal structure. The ants were alive in the nest when I received it. They were chloroformed before sectioning the nest. I took from the nest about one-fourth pint of adults, pupæ, and larvæ. They were collected in a mass through the chambers within a space four inches in length of the nest. This space is about two-thirds the distance from the lower end. The material composing the cells in this space is lighter in color than the other internal parts. It appeared also in the photograph as can be seen by looking at the right-hand figure. Probably it will be visible in the photoengravure.

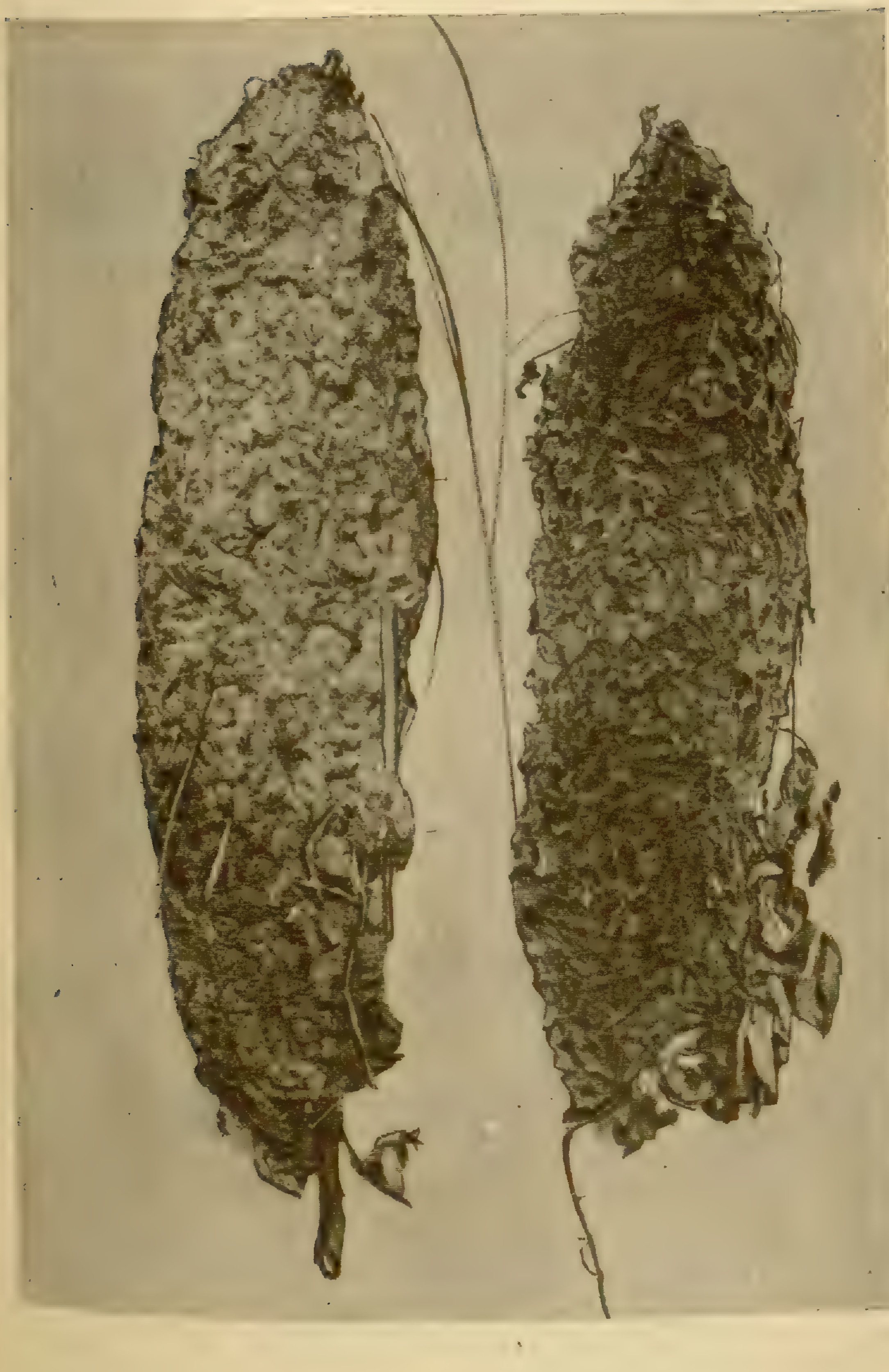
The material used in making the nest seems to be the same used by the ant in making its nest under stones, etc. Beside the woody pulp, a microscopic examination seems to reveal also some portions of dried grass. The nest is supported by the branches of the bush; a vine and some stalks of marsh-grass are fastened in it. Upon the outside the material is of a light gray color, much like that of the nest of the white-faced hornet. In the interior it is darker, in some places almost black. Probably the high tides causing the creek to overflow forced the ants to build their nest above the high-water mark instead of under

[1] This department is edited by Prof. J. H. Comstock, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

[2] The ant was determined for me through the kindness of Prof. C. V. Riley.

[3] Comstock's Report on Cotton Insects, 1879, p. 188.

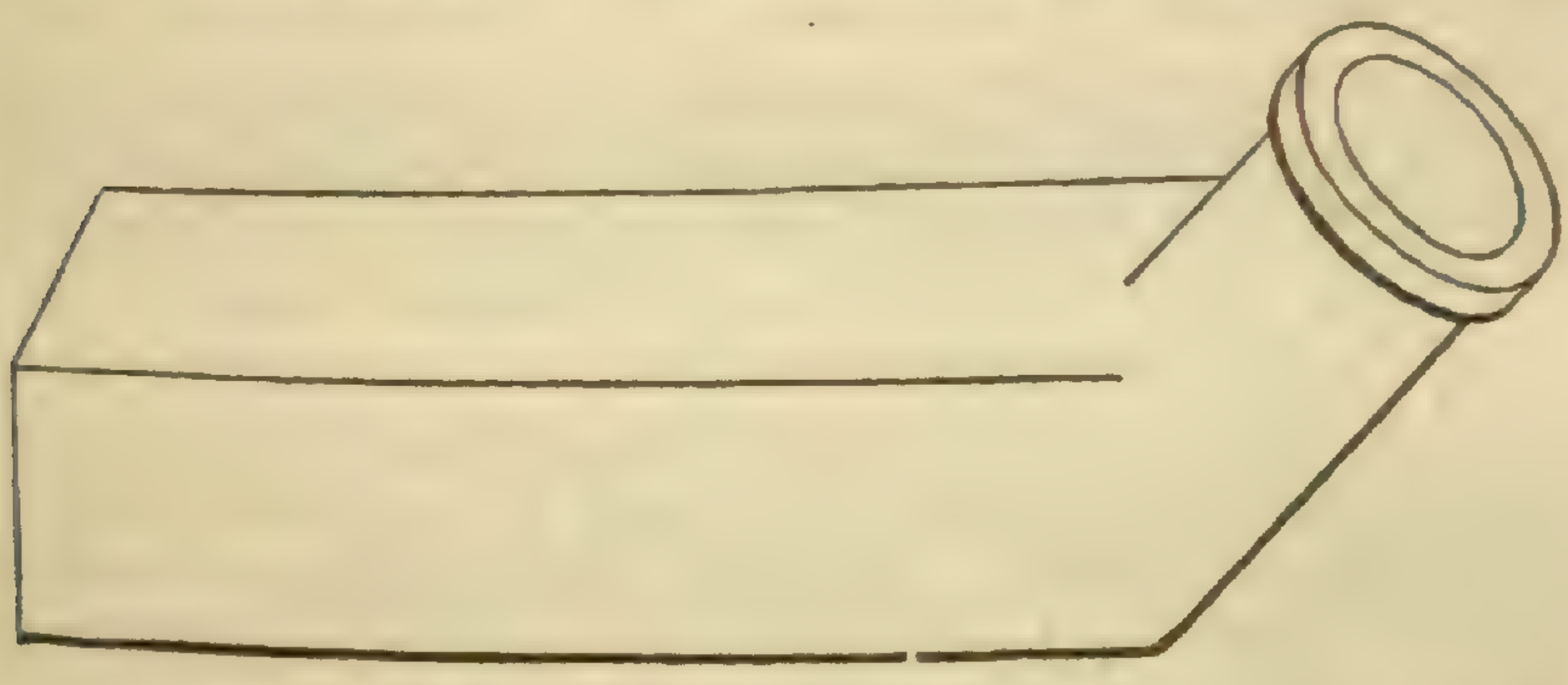
PLATE XXVI.



stones and within logs. One cannot help thinking that possibly some species of Hymenoptera, which now altogether build elevated nests, once built them near the ground, and being forced for a long time by conditions surrounding them, similar to these, finally acquired that habit permanently.

This would seem more plausible if General Lewis is correct in a fact which he states, that the yellow-jackets along Holly Creek, in Pender County, build nests on the bushes to avoid the tide. I mean to investigate this and see if they are the same species which under ordinary circumstances build nests in the ground. —*Geo. F. Atkinson, Univ. of N. C., Chapel Hill*, July 7, 1887.

A New Form of Vial for Alcoholic Specimens.—Frequently in Natural History museums it is desirable to display alcoholic specimens in vials placed in a horizontal position. This is true where table-cases are used; but it is more especially so in entomological cabinets, where the insect-boxes are in the form of



drawers. The use of the ordinary vials or insect-tubes in these cases is attended with serious difficulties. It is almost impossible to prevent the leakage of alcohol, and the consequent destruction of the specimens. In addition to this, the curved sides of the vial or tube make the contained specimens appear of very different form from what they really are. A long slender larva will appear to be much thicker than it is, while its length will not be magnified. A student, therefore, who does not remove the specimen from the vial will be misled as to its proportions.

To meet these difficulties I have had made a vial of the form represented in the accompanying figure. The bending of the neck prevents the leakage of the alcohol, and the plain sides prevent the apparent distortion of the specimen.

To fix the vial in place in an entomological cabinet, a white card is fastened to its lower side with liquid glue (the acetic acid and alcohol solution); the card is then trimmed close to the sides of the vial, but is allowed to project a short distance beyond each end. By means of these projections the bottle can be fastened in place with small pins.

The mould for these vials is the property of Cornell Univer-

sity, but it is with Whitall, Tatum & Co., New York, of whom the vials may be obtained.—*J. H. Comstock.*

Synopsis of the Hymenoptera of America North of Mexico.—It is with much pleasure that we call attention to a work by Mr. E. T. Cresson, which bears the above title, and the first part of which has just been published by the American Entomological Society.

The study of the Hymenoptera has been much neglected in this country, notwithstanding the great extent of the order, the wide range of variation in structure presented by it, and the fact that members of it exhibit the most wonderful development of instinctive powers known. This neglect of the order by students generally has been due to the fact that no specialist has heretofore given us a general work by means of which our forms can be determined. But we have now in this synopsis a guide which will enable the student to take up the study of the Hymenoptera and make satisfactory progress. The student who undertakes this work, however, must not expect to find the order as well worked up as are the flowering plants of our Flora, or even the Coleoptera of our Fauna. For, as stated by Cresson, "the greater part of the material collected together in the larger families has been very imperfectly studied, and our knowledge of the characters is very incomplete, so that years of careful study will be necessary before a classification can be produced that will be approximately complete." But this work will do much by the attraction of attention to the order to hasten the day when we shall have a complete classification. And it adds an order to the small list of groups which are available for study by other than specialists.

The part published consists chiefly of analytical keys for the determination of the families and genera. Many of these tables are compiled from the special papers of Wesmael, Holmgren, Westwood, Thomson, Taschenberg, Norton, Marshall, Andre, Mayr, Saunders, Howard, Cameron, Ashmead, and others. The second part, which is now in press, will contain a catalogue of the described species and bibliography, as well as a complete index. It is expected that the volume will consist of about 325 pages.

Liquid for Preserving Larvæ.—The following formula for the preparation of a fluid for the preservation of larvæ is given by Mr. Henri Trois (*Atti R. Istit. Veneto*, (6) tomo iii.).

Common salt	gr. 235
Alum	gr. 55
Corrosive sublimate	centigr. 18
Boiling water	litres 5

When the liquid is cold add 50 grains of carbolic acid. Let the liquid stand five or six days, and then filter. It is claimed that by means of this fluid the colors of larvæ can be preserved perfectly, even when exposed to a strong light.

ZOOLOGY.

Turning Hydra inside out; a Correction.—Will you allow me to correct a slight mistake that has crept into the pages of the AMERICAN NATURALIST? On page 387 of the April number it is stated that I have succeeded in turning Hydra inside out. The credit of having accomplished the feat should be given to Mr. C. Ishikawa and Mr. M. Kikuchi, both my assistants at the time. They devised simple but ingenious instruments for the purpose, and made the task of turning Hydra inside out a comparatively easy one, as I can testify from personal trial. Mr. Ishikawa made at the time many observations on the behavior of Hydra thus turned inside out. So far as I remember, Hydra, under these circumstances, generally quickly gained the right side out again, and if forcibly prevented from doing so by having a bristle put through its body, it still made frantic and almost laughable efforts to right itself. No definite results were reached, so far as I can recollect, in regard to the change of functions in the layers of the body,—at any rate something interrupted Mr. Ishikawa's observations before any definite conclusions were obtained, and that is the reason that nothing has been published until now. I hope that Mr. Ishikawa will take up the investigation again some time, and throw more light upon this interesting subject.—*K. Mitsikuri, Imperial University, Tokio, Japan*, June 2, 1887.

A Remarkable Case of Phosphorescence in an Earth-Worm.—On the night of June 20, 1887, when returning from placing some Phengodes females where they might attract the males, I saw in the path before me a small phosphorescent light. As I approached it became larger; now an inch, and the next moment two inches long. I was on the point of declaring I had found another Phengodes when suddenly it became three, four, and six inches long, now darting in this direction and then in that.

Thinking there might be an insect capable of running and giving a phosphorescent light to objects in its path in such a way as to cause them to be illuminated for a short time, I struck a match so that I might see to capture it. As the light of the match overcame the phosphorescence and lighted up the objects on the ground, the only insect I saw was a Myriapod scampering away under the leaves. All this took place in less time than it takes to tell it. Thinking the insect was hidden under the leaves, when the light of the match was extinguished I began to brush them away with my hand. The phosphorescence appeared again,

and the light advanced as rapidly as I moved my hand. I thought certainly I was in pursuit of the prize, and in my anxiety to capture it I would catch up a whole handful of earth. But I always noticed that I left the phosphorescent light on the ground. The insect eluded me, I thought. After pursuing the phantom in vain for some time, I stopped to ponder. After the habit of a puzzled man in an inquiring mood, I brushed my foot across the earth before me, when lo! each little pebble and pellet of earth bristled with a phosphorescent light. For a moment I seemed to lose confidence in the fact that all such phenomena are due to natural causes. The air was sparkling with fire-flies, and the earth at my feet was bristling with phosphorescence. Had time sped backward twenty centuries, and were the vestal fires lighting around me? Or was some great calamity impending? I seemed to hear these words repeated from the sky: "*Nate dea, quo fata trahunt retrahuntque, sequimur; Quidquid erit, superanda omnis fortuna ferendo est.*" But in a moment more I had brushed away these delightful superstitions, and went to work to find the *cause*.

Taking a quantity of the earth, I went to my study. First I took several pebbles into a dark room and rubbed them in my hands; no light appeared. Then I took some pellets of earth and treated them in like manner; result the same. Surely, I thought, the phantom lies in these decaying leaves, but disappointment was also the result of the third investigation. I returned to my package of earth, and saw a lone earth-worm writhing in pain. "I will try him," I thought. I took it into the dark room. It showed no sign of phosphorescence. I rolled it once across my hand. The *phantom* became *real*. Not only was the whole body of the earth-worm luminous, but the entire palm of my hand was aglow with phosphorescence. I made several trips to the place, and secured other worms which exhibited the same peculiarity.

Probably the Myriapod which I saw had pounced upon one of these worms for a meal. It became phosphorescent, which may have frightened the Myriapod, and it ran, dragging its prey, and the worm's body touching the ground illuminated it, thus attracting my attention. When the earth is disturbed, the friction of the body against the particles gives phosphorescence to them. The earth-worm is probably a species of Lumbricedæ.—*Geo. F. Atkinson, University of North Carolina, Chapel Hill, N. C.* July 7, 1887.

Dwight on the Teleology of Bone-Structure.—Professor Dwight, of Harvard, thus concludes a paper on the cancellated structure of the bones of Vertebrata, in the Memoirs of the Boston Society of Natural History: "It appears, therefore, evident that so far from the actual structure of the bone

being the only possible one, it in many cases presents useless features, and that certainly there must be some determining factor besides teleology. Is it impossible to hold that the vertebræ of an alligator, for instance, could not answer their purpose equally well if the internal structure were more on the plan of mammalian vertebræ? Are there, then, not peculiarities of race that, in some cases at least, do not answer any definite purpose? It seems to me that there can be no reasonable doubt on the matter. It may be urged that we lack the knowledge to decide whether any given organism considered as a whole is or is not as good as its nature admits. It may be urged that an essential element of perfection is the due proportion of parts and faculties, and that it is impossible for us to say that the greater development in some particular direction would be for the welfare of the individual. I have no desire to dispute the great truth underlying these propositions, but in view of rudimentary organs alone, it would appear that, at least in some subordinate details, useless structures occur, and we have no means of deciding what limits to assign to the action of the causes producing them. It is certain that these appearances are not due to chance; there must be some determining cause modifying the structure in this direction. It is customary now to quote rudimentary organs and anatomical anomalies as evidences of descent, but it seems to me very improperly, occurring as many of them do quite out of the line of inheritance. This criticism applies with greatest force to anomalies, but rudimentary organs seem phenomena of the same general class. What principle, then, shall account for them? We must turn to homologies. We see within vertebrates a general plan; and, though great modifications occur, the plan persists. No liberties, so to speak, are taken with it beyond a certain point. There are never, for instance, more than two eyes or one mouth or four [*sic*] pairs of limbs. Is there reason to be sure that none of these, or analogous modifications, might not be for the benefit of the individual? Yet I think every student of natural history would look on the suggestion that they will never occur as chimerical.

"The principle of homology has a restraining influence on variations of structure, both in quasi-accidental instances, as in anomalies, and in transformation, of species (if that occurs), by restricting changes within the limits of the general plan.

"To condense further these deductions, it appears that the internal structure of any particular bone may show evidence of three factors: first, that of teleology; second, that of homology; third, that of correlation to the structure of other bones of the same animal. The relative prominence of these factors varies greatly. For example, in the humerus of the whale the first is of little moment, and so is the third in the heel-bone of the seal. Thus, while we find provision for the fitness of the part, we find

also sometimes apparently useless structures, sometimes apparently evidences of degeneration, but throughout are more or less distinct marks of harmony with other parts, and of homology with other forms. How has this been accomplished? Clearly the crude notion that accidental, purposeless, external forces should be sufficient to change by slow degrees one such organism into another of a different species is untenable. The doctrine of chances alone shows it to be impossible. There is, moreover, the unanswerable argument of the inevitable uselessness of incipient structures. Where we see the need, we see the structure to meet it already perfect. We see also the combination of homology with teleology. Whatever, therefore, the share of evolution may be in the production of species, it is not one of chance. The changes must be for the most part comparatively sudden, and therefore due to an implanted, internal force acting in predetermined directions. On the theory of external accidental forces, the preservation of homology is incomprehensible. The action, however, of this internal force is, no doubt, modified by accidental secondary causes, which may produce degenerative as well as progressive changes."

Note on the Food of Amblystoma mexicanum.—In a recent note in *Science*[1] Dr. R. W. Shufeldt has placed on record some interesting "Notes on the Diet of Amblystomas," in which are given his experiments with meats of one and another sort in connection with captive specimens of the common *A. mavortium* of the Rocky Mountain regions. It has occurred to me that the following brief notes, incidentally made during the past winter, and based upon the contents of the alimentary canal of several alcoholic specimens of the common Mexican *Amblystoma* from Lake Texcoco, may prove interesting as connected with the ordinary food-habits of the free form. During the examination of some thirty specimens, conducted for anatomic purposes, it was found that twenty-two individuals contained from one to five specimens of *Cambarus montezumæ* Saussure,[2] some of which were still entire. Five specimens contained numerous examples of *Physa mexicana*, intermingled with which were many fragments of insects. In nearly all the specimens occurred many *Gammari* sp. indt. One individual contained a *Pisidium*, closely allied to *P. abditum*, associated with a half-digested minnow too much decomposed to admit of generic determination; the fish, when entire, must have been three inches in length. No plant-remains were found, save a few small roots, which were invariably associated with the *Cambari*, and doubtless swallowed with them. More or less

[1] Vol. ix., No. 216, p. 298, March 25, 1887.

[2] I am indebted to the courtesy of Prof. Walter Faxon, of Cambridge, for the determination of this form.

mud was found in every stomach examined, the greatest quantity in those stomachs containing the *Physæ*. Attached to the fauces of several individuals were found sometimes as many as a half-dozen specimens of a nematode worm belonging to *Strongylus*. The stomach of one individual was completely devoid of food-remains of any sort, but was completely filled with clusters of this nematode hanging from its walls.

It would seem, therefore, that in a free state *Amblystoma* is carnivorously omnivorous.—*R. Ellsworth Call.*

The Turkey-Skull.—Dr. R. W. Shufeldt has recently published the results of his comparisons of the skulls of wild and domesticated turkeys, undertaken with a view of noticing the changes brought about by domestication. His results in brief are:

1. In the wild bird the nasals fuse with the frontals, but in the domestic bird they are separated by a persistent suture.

2. In the wild turkey the cranio-frontal region is wider and more concave than in the tame variety.

3. The parietal prominences are more evident, and the median longitudinal from these to the occipital ridge is shorter in the wild than in tame birds.

4. The occipital area in the wild turkey is cordate, the apex upwards; in the tame turkey it is roughly semicircular.

5. The intraorbital septum is entire in the wild bird, perforate in the tame.

6. The pterygoids are longer and more slender in wild than in tame varieties.

7. The skull is denser and thicker, as well as smoother, in the tame than in the wild bird.

These points and three others mentioned by Dr. Shufeldt hold good for the majority of specimens, but in a large series of skulls examples may be picked out which are intermediate in position. The characters are all comparative, and exceptions are numerous. The studies are not of a diagnostic but of a comparative character, and form an interesting addition to our knowledge of the changes produced by domestication in a comparatively short time.

Anatomy of the Auks.—Dr. Shufeldt, in studying the visceral anatomy of specimens of *Brachyrhamphus marmoratus* and *Synthliborhamphus antiquus*, notes that these two forms, closely allied in the systems, differ greatly in their visceral anatomy. In the ancient murrelet the lower part of the larynx is covered in front by a large mass of fat, lacking in the marbled murrelet. The lateral and sterno-tracheal muscles are the only tracheal muscles present, and these agree quite closely, except that the latter are given off much higher in the marbled than in the ancient murrelet. The differences in the hearts are quite marked, but may result from the action of the preserving-fluid, as this

organ is described as smaller and more pointed in one than in the other. The livers differ considerably, being longer and larger in the ancient than in the marbled species. Considerable differences are also noted in the full bladders. Dr. Shufeldt calls attention to the fact that well-preserved spirit specimens of many Arctic birds are still desiderata in our museums, and requests others who may have the opportunity to make comparative studies on other auks.

Domestication of Wild Fowl.—My success so far this year has been better than last, although far short of what I expected. There seems to be no available information on this subject, at least none that I have had access to, and I have for the past few years been learning from failures. Last year I hatched four Chinese mandarin ducks and they lived a week. Their deaths may be attributed to close confinement, and, perhaps, to an artificial diet of corn-meal, boiled potato, and boiled egg.

This year I turned out in a swampy piece of land, with a large spring pond in it, seventeen pairs of wood-ducks, ten odd drakes and one pair of pintails. They were confined on about an acre of ground by a wire netting three feet high.

All winter these birds had been together and had paired off. They were confined in a small enclosure near one of the windows of the fish hatchery, and were at all times in sight, and it was noticed that the females made all the advances through February and March. Therefore the extra drakes were thought to be harmless. About the first of April they were turned out in the swamp, and furious fighting was noticed among the males, and by the middle of April three of the ducks were seen with their scalps torn off. It was also noticed that the males gave them a rest, and then, perhaps too late, the extra males were removed. Nests were provided for them by placing boxes about two feet from the ground in the alders, and in one of these a duck laid ten eggs; in another three were laid, and two eggs were found upon the ground. These were placed under hens, and from them I have three young, now, July 8, two weeks old, which are strong and vigorous, but refuse all food that we offer, and spend their time in catching flies. They roam out alone, but come up to the building with the old hen.

Back of my house, around a fountain, we made an enclosure which provided a good run of grass, and there I placed one pair of mandarins and four pairs of wood-ducks. The wood-ducks did not lay, but the mandarin laid twelve eggs; nine of these were placed under hens, and five hatched. Three eggs were left with the mandarin, and after setting a week she abandoned them. Of the five mandarins two were killed under the hen. One was a perfect albino, but lived only four days; the remaining two are vigorous.

In a ravine which has a spring pool in it I placed two pairs of blue-wing teal. One of these birds was the mother of the rest, and was raised by a man in Iowa, but no eggs have been laid by them.

My pintail duck made her nest on the ground in a clump of ferns, and set on seven eggs. The day that she was due to hatch she disappeared, and no trace of her, the young, or even the egg-shells, remain. We think she escaped somewhere, perhaps over the netting, for I have seen a wood-duck, although pinioned, go over a wire netting, by means of feet and wings, when first placed in strange quarters. They would go up with a sort of running fly and fall on the other side.

It is possible that, had the wood-ducks been turned out in pairs, and no odd drakes been placed with them, the result would have been better. There is a great deal of natural food in their enclosure, and they have all the corn, wheat, and oats that they can eat; they prefer corn to anything else and eat that first; next they take wheat, and only eat the oats when nothing else is left.

Next year I hope to try again under slightly different circumstances, such as proper mating and different food, and in the mean time I will be glad to have the experience of others in this line.—*Fred. Mather, Cold Spring Harbor, N. Y.*

Zoological News.—ECHINODERMS.—In the *Zoologische Anzeiger* for May 31 H. Ludwig points out that the so-called parasite of Pterotrachea described by Barrois under the name *Trichælina paradoxa* is in reality the pedicellarium of some Echinoid (probably *Sphærechinus granulatus*) which had become detached. It was regarded by Barrois as a problematical form with Echinoderm affinities.

The readers of Romanes's work upon starfishes will be interested in Dr. Preyer's experiments on the motions of these forms as detailed in a late number of the *Mittheilungen* of the Naples Zoological Station.

WORMS.—Mr. A. G. Bourne, now in India, writes to *Nature* of June 9 calling attention to the sensory powers possessed by the leeches. After alluding to Whitman's observations on the land-leeches of Japan, he records that he took a stone from the bed of a brook with his hand, and almost immediately several leeches came swimming to the spot. Thinking that smell or taste might have had something to do with attracting them, he returned the next day and stirred the water with a stick, but without producing any result. He then washed his hands in the water, taking care not to disturb the ooze on the bottom, when the leeches reappeared and swam about as if they realized the presence of a living being.

Ludwig Plate describes, in the seventh volume of the Naples *Mittheilungen*, some new ectoparasitic Rotifers from the Gulf of Naples. They belong to the family Seisonidæ, and, like all the other members of the group, occur attached to Nebalia. The forms described, four in number, belong to the new genus Paraseison, which is characterized by an absence of intestine, and has the wheel either as in Seison, or reduced to tactile bristles, or, lastly, entirely absent. The other genera of the family—of which a synopsis is given—are Seison of Grube, with two species, and Saccobdella of Van Beneden and Hess, with a single species.

Molluscs.—Prominent among the papers in the twenty-sixth volume of the *Journal de Conchyliologie*, just completed, may be mentioned an account of the Molluscan fauna of the valleys of the Tage and the Sado, Portugal, by Nobre; descriptions of new species of Molluscs from Annam, by Wattebled; from Cambodia and Tonkin, by Morelet; and from China, by Hende.

EMBRYOLOGY.[1]

A Theory of the Origin of Placental Types, and on certain Vestigiary Structures in the Placentæ of the Mouse, Rat, and Field-Mouse.—The discoidal placenta has been supposed by Balfour to have been derived from an earlier and less specialized diffuse type. He, however, gave no connected, and, as it seems to the present writer, no plausible view as to the causes leading to the gradual restriction of the placental area. Although I have already given partial expression elsewhere to the following views, I am now able to state them with greater clearness, owing to the fact that the placentation of the common mouse has very unexpectedly afforded some remarkable evidence in proof of the doctrine of the mechanical genesis of placental types first suggested by me.

The view which the writer holds is essentially as follows: (1) The primitive form of the placenta approximated that of the so-called diffuse type. (2) The primitive type of uterus was duplex or bipartite, and its cornua were therefore tubular. (3) Development in one of the cornua of such an uterus, as the blastosphere enlarged, must have caused the latter to touch the uterine mucosa around a zone embracing its equator, just as a sphere thrust into a flexible tube would be in annular contact with the inside of the latter. (4) If the blastosphere became elongated or fusiform within the tubular uterine cornua, as in Carnivora and Ungulata, a still greater portion of the outer surface of the blastosphere would be brought into contact with the mucous membrane of the tubular uterus, and the conditions for

[1] Edited by John A. Ryder, Ph.D., Biological Department, University of Pennsylvania, Philadelphia.

the development of the zonary, diffuse, or cotyledonary placenta would be established.

Just here it may be well to call attention to the fact that the bare poles of the chorion in the diffuse type of placenta, as seen in the Mare and Dugong, show conclusively that we cannot draw a sharp line of demarcation between the diffuse and zonary types of the placenta. It follows, without any doubt whatever, from what has been said in the preceding paragraph, that the so-called diffuse type of placenta is merely a special case of the zonary, in which smaller polar areas have been left bare of villi because of more extensive contact of the chorion with the uterine mucosa. These small, bare areas of the chorion in the diffuse represent the larger, non-villous poles of the zonary type; so that, in reality, all so-called diffuse placentæ are zonary,—*i.e.*, they are a very wide type of the zonary, in which the villous belt extends over nearly the whole of the outer superficies of the chorion.

It may also be safely affirmed that the decidua acquires importance in proportion to the concentration of the placental or villous area of the chorion, because in the diffuse type the decidua is either meagrely developed or wanting.

The concentration or diminution of the placental area also depends, to a great extent, upon the degree to which the allantois is extended over the subzonal membrane; but the gradual restriction of the area covered by the allantois must have had some determining cause. The influence which would be adequate to produce such a restriction could only be a physiological one, determined by the mechanical relations of the parts involved, and it is therefore almost certain that the extension or restriction of the allantoic area would be determined by the proportions of the surface of the chorion brought into contact with the vascular walls of the uterus, or by the restriction of the vascular and deciduous area in the walls of the uterus itself. The last-mentioned type of restriction is of great importance in connection with the origin of the discoidal type of placenta, because it is probable that from the diffuse type of placenta the zonary has been derived, while from the latter it is in the highest degree probable that the discoidal has arisen in virtue of the restriction or reduction of the maternal vascular and deciduous surfaces of the uterus. The new evidence, which I will now present on this point, as observed in *Mus musculus*, *M. decumanus*, and *Hesperomys*, will, it seems to me, leave little doubt as to the essential correctness of the views set forth above, even after we make due allowance for the effect of uniparity and pluriparity, because it is very probable that pluriparity has tended to preserve the primitive bipartite or duplex type of uterus with its right and left tubular halves, in order that a number of fœtuses could be nourished in each uterine tube at one time, as in Rodentia.

In the latter, when the fœtuses are somewhat less than half

grown, it is very evident that there is an annular thickening of the uterine wall (shown at *v* in A and B of Fig. 1). Dissection reveals the fact that this annular thickening is nothing else than a part of the decidua, as it is closely adherent to the fœtal membranes, and extends from either edge of the decidua of the discoidal placenta (*p*) around over the back of the embryo, as shown at B and C in Fig. 1. This thickened portion, or decidua, isolated, together with the placenta, and unrolled upon a flat surface, would appear as shown at D in Fig. 1. The question immediately arises, What is the nature of this structure? It seems to the writer that there can be no question that its position

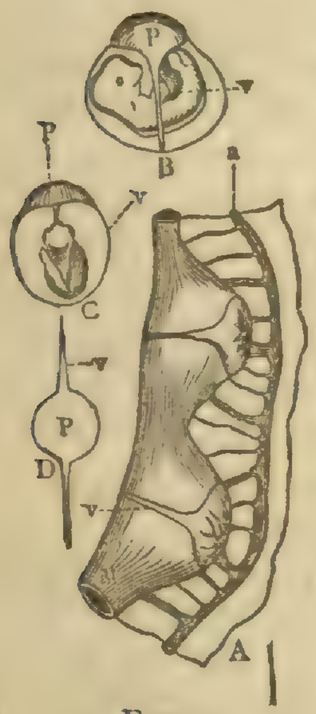


FIG. 1.

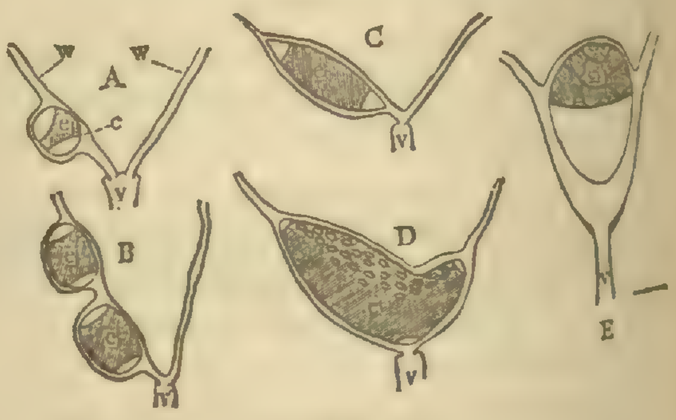


FIG. 2.

relations indicate that it is a vestige of the zonary type of placenta which must have been developed in the ancestors of the Rodentia.

All of the placental girdle, in the light of this evidence, has been aborted in the Rodentia, except a small discoidal segment nearest to the blood vascular supply on the mesometric side of the uterus, as shown at A in Fig. 1, where *a* represents the uterine artery (the vein has not been indicated in this diagram). The functionless part of the decidual girdle in existing murine types shows that the ancestral Rodentia possessed a zonary placenta. We may confidently affirm this, in spite of the anomalous mode of development of the Cavys and Murine types, because there is good reason to suppose that the types of development presented by both the latter have been derived by descent with modification from a type approximating the more primitive one which was similar to the less specialized mode of development of the Rabbits and Hares.

We may suppose, further, that the zonary girdle first began to narrow and abort on the side of the uterine tube opposite to and most remote from its mesometric aspect, and, consequently, farthest away from the blood vascular supply of the organ. This is shown diagrammatically in Fig. 2, at A, where *w* represents the wall of the left and *w'* that of the right uterine tube, *c* the chorion, *e* the placental girdle and the form of the area covered

by the decidua, and *v* the vagina. We may suppose Fig. 2, A, to represent a type intermediate between that shown in Fig. 1 and that represented in Fig. 2, at B, which is that characteristic of certain Carnivora,—the Cat, for example. In C, Fig. 2, the hollow chorion has become more elongated,—in fact, fusiform; its bare poles are conical instead of flat, as in B, while the villous portion, *e*, is a broad zone. This type is found in the Dog and in *Phoca*, in which, at certain stages, it is very strongly marked. In all these types placentation occurs exclusively in either the right or left half of the uterus, but in the still more specialized uniparous types, to be next described, we find that portions of both right and left halves of the uterus present more or less mucous surface to the single chorion which they enclose. In spite of this, however, we may still discover traces of the zonary condition in D, Fig. 2, which represents the relations of the chorion to the right and left horns of the uterus in the Mare and Dugong, while, if the villi are aggregated into little tufts mainly on the mesometric side, as shown by the small, oval areas, we would have the condition found in the Cow. In this last type we find three bare areas on the chorion,—viz., at either pole, and another overlying and exactly opposite the *os uteri*, as shown in D, Fig. 2.[1] In the so-called diffuse type, represented by D, it is clearly seen that the villous zone is a very wide one, and it is also clear that the type D must have been derived from one similar to that shown at C, Fig. 2. In fact, if the chorion and embryo in the left horn of C were slipped down so as to lie partly in the right horn, we would get a condition practically like D. With the still greater specialization of the uterus, as a result of which its cavity is no longer tubular, but pyriform, in the gravid state, as shown at E, Fig. 2, other modifications of the placenta supervene. The globular chorion found in the type E (uterus simplex of Man, Apes, and several Edentates) still tends to develop the placenta at the cardiac or mesometric side. In the case of *Tamandua*, *Cycloturus*, and *Bradypus* there is a more or less well-marked lobulation of the discoidal placenta, which is probably a reminiscence of cotyledons which have suffered approximation, as the type of uterus D passed into that shown at E. In the Primates the simple discoidal placenta of the highest types and the two unequal placental disks of the Old World monkeys are further modifications of a type which must have been primitively zonary or diffuse, as is proved by the placentation of the Lemuridæ, which is similar to that of D, Fig. 2. Such a view is further countenanced by the fact that in its earliest condition the placenta of the Primates is essentially diffuse in its character.

[1] These bare areas seem to have arisen in consequence of the failure of the surface of the chorion to come into intimate contact with a vascular maternal surface at these points.

The facts as interpreted above seem, to me, to leave no doubt regarding the great influence which variation in the mechanical relations of the chorion to the uterine walls has exercised in the evolution of placental types. This, coupled with the influence exerted by the varying fertility of species, the variation in the vascularity of different parts of the uterine walls, and the form of the uterine cavity, has, doubtless, been the all-important factor in the evolution of the various existing types of gestation.—*John A. Ryder*, June 24, 1887.

ANTHROPOLOGY.

Arrow-Release among the Navajos.—Yesterday (28th March, 1887) I was out with my camera upon one of the hills which closely surround the frontier military post of Fort Wingate, New Mexico. On the site referred to are built three Navajo lodges, or "hogans," as they are called,—two of the old original structures of the tribe and one of the more recent dwellings, or plan of building. Having made my intentions known, that I desired a picture of a warrior in the act of shooting his war-bow, there soon gathered about me some eight or ten venerable-looking old Navajo bucks, two or three of whom had their war-bows and arrows with them.

Having just read with great interest Professor Morse's pamphlet on arrow-release, a copy of which he had kindly sent me, it was with no little curiosity that I handed a bow and two or three arrows to an old gray-headed warrior present, and asked him, "Draw,—as if you were about to kill the worst enemy you had in the whole world." A particularly savage expression came over the old fellow's countenance at the suddenness of my request, but he seized the bow and arrows, and immediately drew one of them to its very head. This is the position he stood in at the time: his left foot was slightly in advance of the right, the bow was firmly seized at its middle with the left hand, while it was held somewhat obliquely, the upper moiety inclining towards the right from the vertical line, and, of course, the lower limb having a corresponding inclination towards the left side. The two spare arrows were held with the bow in the left hand, being confined by the fingers against its right outer aspect. With the right hand he seized the proximal end of the arrow in the string, using the thumb and index finger, at a point fully an inch or more above the notch, and consequently including the feathers. The "ring finger" bore against the string below this seizure, and its pressure was reinforced by its being overlapped by the middle digit, the little finger being curled within the palm of the hand.

This corresponded to Professor Morse's "secondary release" as figured on page 8 of the above referred to pamphlet, with the exception that the middle finger should overlap the annularis,

and was not of itself used to draw back the string. Returning to our Navajo warrior, I noticed, too, that the arrow at its head was on the *left side* of the bow and simply rested on top of his clinched hand. This man wore, in common with all the others who used the bow, a stiff leather "brace" fastened by buckskin strings about his left wrist, the collar being about two inches deep, and this in several others who stood near and who wore them was ornamented with silver buttons. He drew the arrow back and forth three or four times without changing the position of his fingers or hands, when I suddenly asked him to shoot as if he were going to kill a squirrel running up a tree. He smiled at this and simply drew the bow the *same way*. Upon further questioning him, he told me that the Navajos rarely held their spare arrows in the bow hand, as he now had them, but carried a scabbard (quiver of buckskin) full in front of them, from which they could be removed with great rapidity while firing; this he pre-eminently demonstrated to me from one of the scabbards worn by an Indian there present.

Still, without letting them know what I was after, I handed the bow and arrow to another buck, a man especially noted for his skill in the use of the weapon, and he immediately assumed precisely the same attitude; whereupon the first old fellow laughed and applauded at the same time, saying, "What did you ask him for? All the Navajos shoot the bow and arrow exactly alike." I replied that I dare say they did, and handed it to a third one, and sure enough he assumed the same position. I was determined, however, to let every one of them try it, and as the fourth fellow seized it, I observed that he steadied the arrow against the bow with the index finger of his left hand, which he extended lightly along the continuity of the shaft. Further, his middle finger did not overlap the annularis, but bore against the string lightly above it. Here was a typical "secondary release," and it was followed up by several others present, so I came fully to the conclusion that the true method of arrow-release among the Navajo Indians was the secondary type as classified by Professor Morse.

Next day I went among them again, and they had evidently been talking the matter over, and several new men being present, they were eager to show me the exact methods.

I found that they *on all occasions* where force was required used the secondary release, but where they shot lightly at short range they used the "primary release." Now, these observations were all made with unusual care on my part, as I had no sooner commenced them than I found that they disagreed with the observations of a no less distinguished observer than Colonel James Stevenson, who reports through Professor Morse in his first pamphlet on arrow-release, "that Navajo Indians practise three methods of release,—namely, the primary release already alluded

to, the tertiary release, and a variety of the Mediterranean release" (pp. 10, 11).

At any rate, as I say, all the Navajos which I examined, when not using the primary release employ in connection with the index finger and thumb of the right hand the annularis digit to assist in drawing back the string when charged with an arrow.

These arrows have an elaborately made "notch," are armed with three feathers, and tipped with thin and flat heads of iron, made sharp with a file. The feathers are attached about an inch above the notch, and are placed at an equal distance apart on the cylindrical shaft. Sometimes the plane of one of these feathers will be at right angles to the notch, but again the arrangement may be otherwise, and I am satisfied they have no special rule in putting them on. Deer-sinew is used to wrap them, as it is to confine the iron head at the distal extremity of the shaft.—*R. W. Shufeldt, U. S. Army, Fort Wingate, New Mexico*, 29th March, 1887.

The Great Serpent Mound.—In the archæological world one of the most important bits of news is the purchase of the "Great Serpent Mound," in Adams County, Ohio, by the Peabody Museum of American Archæology and Ethnology. At the time of the explorations of Squier and Davis (1849) it was covered by a heavy growth of trees, but most of them were prostrated by the great tornado of 1859, since which time the elements have seriously damaged it. Knowing this fact, Professor F. W. Putnam, of the Peabody Museum, wrote a letter advocating the preservation of this prehistoric monument, and as a result several ladies of Boston have raised money sufficient to buy the mound and about sixty acres of land about it. It is the intention to convert this into a public park, erecting a fence around the portion containing the mound, so as to keep out horses and cattle. Professor Putnam will revisit the mound in the fall and superintend the improvements. A grove of trees will be left outside the fence, where picnic-parties may assemble. The mound itself is a long earthen embankment on the edge of a bluff a hundred feet high. For the greater portion of its course it coils in a very snake-like fashion, the tail being coiled in a spiral, like a watch-spring. The head of the serpent is represented as wide open, and in front of it is an oval about ninety feet long, and still farther in front of this, extending to the point of the bluff, is an ill-defined portion which some have likened to a jumping frog, while others think it is merely produced by cattle-tracks. "Accurate measurements of the length of the serpent vary all the way from about seven hundred to fifteen hundred feet, the last two surveys giving totals of twelve hundred and forty and fourteen hundred and fifteen feet; some of the discrepancies being explicable by the difficulty in following the centre of the constantly-curving outline. It is certainly fortunate that this, one of the most wonderful of the In-

dian mounds, is thus assured of preservation, for many others are fast disappearing by the action of the rain and of the plough.

The Ruined Cities of Yucatán.—Mr. E. H. Thompson, United States consul at Merida, Yucatan, has been making researches among the ruined cities of that region, and concludes that a moderate view must be taken of their age. They are not as old as some anthropologists believe, nor are they so modern as Charnay holds. He explains their present ruined condition by the climate and tropical vegetation combined with faulty construction. The dirt and débris which in many localities serve as an index of age and as a basis for chronological computation are here lacking. As all these ruins are built on mounds or hills, all accumulations of matter about them can come from only two sources,—that brought there by living forms and that resulting from the decay of the structure itself, while the winds sweeping through the deserted corridors will carry away the smaller portions of that thus accumulated. In regard to the uses of these buildings Mr. Thompson differs from most archæologists, who have come to regard them as communal dwellings. Mr. Thompson rather inclines to the view that the dwellings of the people covered a large space, but, being built of perishable materials, have entirely disappeared. In reply to the statements of eminent archæologists that no traces of such towns exist, he quotes the case of Labna, which is rarely visited, even by the natives themselves. The whole region for leagues around this ruin is dotted with low mounds and small, rectangular terraces, some hardly raised above the surrounding level, while others are of greater altitude, though none are so high as the mounds which support the ruins. Now, asks Mr. Thompson, "if these do not mark the sites of what were once dwellings, to what purpose can we conceive that they were put? Those who are familiar with the habits engendered by a life in the tropics will be ready to affirm that they were not built simply for the pleasure of working." Further, they are too numerous and in such situations as to forbid the idea that they were the sites of additional temples. Mr. Thompson is continuing his explorations of Labna, which promise to give good results, as the locality has been almost entirely undisturbed.

SCIENTIFIC NEWS.

—Professor E. N. Horsford, of Harvard, has recently done a good work in printing Zeisberger's Indian Dictionary. David Zeisberger was a Moravian missionary, who began his labors among the Delaware Indians about 1740, and continued them uninterruptedly for sixty years. In this way he acquired an extensive knowledge of the Delaware tongue, while the fact that the Delawares were vassals of the Iroquois gave him an opportunity to become acquainted with the Onondaga language. When he died his manuscript dictionary passed, after various vicissitudes, into the library of Harvard College, where it was recently found. In publishing it Professor Horsford has not ventured to alter in the least the manuscript of the old missionary, so that the printed text reproduces exactly the original, except in chirography. It makes a volume of two hundred and thirty-six pages, printed in four columns, English, German, Onondaga, and Delaware, the English rather peculiar and the German somewhat antiquated. An edition of the work has been given to Wellesley College, to be used as exchanges in filling the alcove of aboriginal literature which Professor Horsford has founded there.

—The report of the New Hampshire Fish and Game Commissioners for 1886, which is just published, gives some interesting statistics. Their principal labors were confined to land-locked salmon and brook-trout. At the Plymouth hatchery they have hatched and distributed three hundred and fourteen thousand brook-trout, one hundred and thirty-five thousand land-locked salmon, six hundred thousand Penobscot salmon, and one hundred and twenty-five thousand of other fish, mostly whitefish and Lake Superior trout. The total number of brook-trout distributed for the year was six hundred thousand. The commissioners say that the enforcement of the game laws has done much good in increasing the numbers of partridge and other game-birds, while in the northern and central counties of the State deer have rapidly increased in numbers, and during the past year were seen in many towns where none have been known for many years.

—Professor Hubert Ludwig, of Giessen, has been called to the Zoological Institute in Bonn, as successor to Professor Richard Hertwig. His place as professor at Giessen has been filled by the appointment of Dr. J. G. Spengel, who has been the director of the Scientific Museum in Bremen. Dr. H. Schauinsland, of Munich, goes to Bremen.

—The Johns Hopkins University fellowships in biology are to be filled for the coming year by A. C. Wightman and H. V. Wilson.

—Dr. Walter Voigt, of Würzburg, has been appointed assistant in the Zoological Institute at Bonn. The position of assistant in the Zoological Zootomical Institute of Würzburg thus left vacant has been filled by the appointment of Dr. Franz Stuhlman.

—It is reported that the Grand Duke Nicholas, of Russia, is an enthusiastic student of natural history, and that he has recently completed a work on the entomology of the region of the Caucasus.

—The Ohio State Archæological and Historical Society announce the beginning of the *Ohio Archæological and Historical Quarterly*, the first volume of which will contain, among other archæological material, a bibliography of the mounds of Ohio, arranged alphabetically by counties and towns. The editorial board consists of Professors George W. Knight, B. A. Hinsdale, W. H. Venable, G. Frederick Wright, and Dr. I. W. Andrews. The yearly volume will consist of about four hundred pages, and will be sent free to members of the society, while to others the price is one dollar per copy.

—The Essex Institute at Salem, Mass., is at last in possession of a home of its own. Founded in 1848 by the union of two previously existing societies, it has always been a tenant until now. For many years it has shared the building of the Salem Athenæum, but its quarters there were far too small, and for several years it has been unable to even provide shelf-room for its library. A year ago it purchased the adjoining estate, and since that time it has been busy in fitting up the large and commodious dwelling-house there for its new purposes. This building is of brick, three stories in height. A small annex, which extends to the roof of the main building, has been rendered fireproof, and will be used for the storage of the more valuable portions of the Institute's collections. The Institute has now a library of over fifty thousand volumes and upwards of two hundred thousand pamphlets. It is rich in historical and scientific works, especially those of the early part of this century. With the expenditure of a few hundred dollars its scientific side would have but few rivals in the United States. The Institute, twenty years ago, placed its natural history collections as a permanent deposit with the Peabody Academy of Science, but it still retains a museum of historical specimens.

—Professor James D. Dana has gone to the Hawaiian Islands for the summer. He will pay especial attention to the geological changes which have occurred since he visited the islands as a member of the United States Exploring Expedition under Commodore Wilkes.

—*Science* has adopted a new form with the beginning of its new volume. It is now a slightly larger sheet than before.

—Mrs. A. T. Bruce, of New York City, the mother of the la Dr. Adam T. Bruce, whose untimely end has been chronicled these pages, has given Johns Hopkins University ten thousa dollars to found a fellowship in biology as a memorial of her so

—Professor A. DeBary, of Strassburg, has received a call the chair of botany and directorship of the Botanical Institu of the University of Leipzig, left vacant by the retirement Professor A. Schenk.

—Dr. W. Branco, who has been a privatdocent at Berlin, goes to the University of Königsberg as professor of geology.

—Dr. Karl Dahl, the zoologist, and Dr. H. Traube, the mineralogist, have entered upon the duties of their professorships at the University of Kiel.

—Mr. Carl Eigenmann has gone to the Pacific coast. He hopes while there to make a study of the Embiotocoid fishes.

—Professor Barton W. Evermann, of Terre Haute, Indiana will spend the summer collecting in the Gulf of California.

—Dr. Karl Möbius, who is well known for his researches in the Bay of Kiel, has been called to Berlin as professor of zoology and director of the museum in the University.

—Professor P. Falkenberg, formerly of Göttingen, goes to the University of Rostock to take the chair of botany there.

—Dr. A. Gravis, who has been at Brussels, has been elected professor of botany at Lüttich.

—Recent Deaths.—May 20, Professor Alexander Ecker, the well-known anatomist and anthropologist of Freiburg, at the age of seventy.——Professor J. E. Areschong, the Swedish botanist and author of several important works on Algæ, at the age of seventy-six.——Norbert Michot, editor of "The Flora of Hennegaus," at Mons, aged eighty-four.——Professor D. F. Didrichsen, professor of botany, at Copenhagen, March 19, aged seventy-three.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Kansas Society of Natural History.—I have to report the organization in Leavenworth of the Kansas Society of Natural History, with the following officers:

Dr. R. J. Brown, President; Dr. Chas. A. Carpenter, Vice-President; W. R. Lighton, Secretary and Treasurer.

The membership assures activity in the work which has been outlined, and this work is to embrace the study of all of the natural sciences, "with special reference to such as are of economic importance to the State of Kansas."—*W. R. Lighton, Secretary. Leavenworth.*

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SCIENTIFIC FACT AND SCIENTIFIC INFERENCE.

BY H. W. CONN, PH.D.

IT is the custom of scientists to regard their contributions to knowledge as the only ones concerning which there is any certainty. They point with pride to the many steps in advance taken by natural science within the last few centuries, and would compare this advance with what seems to them the stationary condition of non-scientific thought. The advances of science are thought to be sure, requiring no retracing, while non-scientific thought can be certain of nothing, one generation pulling down the structure of the last, only to put in its place an equally unstable conception. Metaphysics has scarcely reached a more certain position than it has held for centuries, for we still find schools and schools of metaphysics, each of which takes an entirely different view of nature. Theology is still divided into numerous beliefs, each bitterly opposed to the others. What little advance has been made our scientists think has been brought about through their discoveries, and they sometimes challenge the production of any positive advance in knowledge which has not been made through the instrumentality of science. Science, then, claims to be the only sure realm of knowledge, and claims that its truths, once established, are established for eternity. The scientific method has indeed been defined as one which accepts nothing without proof, in contradistinction to the unscientific method, which is willing to accept entire many theories and beliefs for which there is no proof and the meaning of which is unclear.

Now, nothing is more plain than that science does *not* confine itself to demonstrated truth. It is easy to find in scientific publications hundreds of theories which have been advanced, defended, disputed, and rejected. Scientific literature is to-day filled with speculations and theories which are no more demonstrated than the most unreliable of non-scientific theories. Scarcely a publication appears that does not contain some new speculation, so that science is burdened with hundreds of unproved, unprovable hypotheses, making it as difficult sometimes to discover accepted truth of scientific teaching as to discover the accepted truth of those lines of thought which we call non-scientific. Yet in spite of this coming and going of hypotheses, or rather, as we shall see later, on account of it, the claim is still that science is the only sure thing, and its conclusions are the only ones that cannot be gainsaid. We find it almost universally recognized, not only among scientists, but among all thinking men, that if a universally-accepted scientific conclusion comes in conflict with any other, it is the scientific conclusion which stands and eventually modifies the other. If this authority for scientific facts is both consciously and unconsciously recognized, it must rest upon some foundation.

Absolute knowledge is, of course, impossible. No matter what we observe or prove, it is always open to the agnostic to deny all knowledge. We can never be certain that our minds are not utterly deceiving us, and that our mental processes are not in contradistinction to reality. We can never prove that the universe is intelligible, nor can we prove that the fact of our minds compelling us to assume nature to act in certain ways shows that nature does act in these ways. It is, of course, useless to attempt to demonstrate the truthfulness of nature or mind; and for this reason scientific observations and conclusions are open to doubt as well as all others. Fundamentally, no one thing is more certain than another, because a question as to the validity of thought affects everything alike. No advance is possible without the fundamental assumption of the truth of mind and nature. We must, then, always start with this assumption, and the question we are to consider becomes this: Assuming the truthfulness of mind and nature, are the conclusions which we call scientific any more likely to be correct than those which we call non-scientific? That they are almost universally

regarded is certainly true. Let us, then, endeavor to find out upon what this claim for superiority rests.

It is frequently said that science's claim for authority is due to its dealing only with facts; but plainly this statement is far from expressing the truth. For, in the first place, all realms of knowledge deal with facts of some sort,—though facts relating to mind may be less cogent than those relating to physical nature,—and, in the second place, science is more than a collection of facts. A process of collecting and narrating facts is not science, for facts have no meaning except as they are compared together, and as conclusions are drawn from them. The significance of science, then, rests upon the deductions from the facts, and not upon the facts themselves. We must therefore carefully distinguish between scientific facts and scientific inference, and consider each in turn.

By scientific facts we mean simple matters of observation, such as that a given stone drops to the ground. In regard to them there can be no doubt that they are everywhere regarded as the most certain factors of knowledge. This certainty seems to rest upon two things,—Firstly, scientific facts themselves are of such a character that they cannot be modified by man nor changed by his imagination. They are beyond the reach of human influence, and we are forced to accept them as true. Now, this cannot be said of the data of other realms of knowledge. We clearly recognize that minds are unlike, and that people think very differently upon the same subject. Some men even deny that there is a right and wrong, or would change the word right for expediency. When a subject such as metaphysics rests upon the introspection of mind alone, it is evident that the personal factor is a large one. Nothing is, perhaps, more certain than the primary laws of thought, and we must assume that, if freed from personal idiosyncrasies, all minds would think alike. But thinkers have not yet been able thus to free themselves; and when it comes to the application of the laws of thought, either the difficulty of the application or the personal factor of the individual becomes so great that contradictory results are reached and the certainty, of course, destroyed. We see from this that mind is open to error, which must be recognized as affecting all but the simplest laws of thought. Mental processes, mental perceptions, mental activities in general, are open to vari-

ation in different persons; but we are confident that the facts
nature are alike for every one, and are therefore more to
trusted than anything open to individual variation. But, s
ondly and primarily, the certainty of scientific facts rests u
the recognition that they need not be accepted as matters of
dence simply, but are of such a nature that they can be repea
and again observed. It is possible to perform a scientific
periment as many times as desired, and with the same res
If any one doubts the results, they can be proved to him
making him observe them. While practically all observa
must be given on matters of evidence, nothing rests ultima
upon evidence, for there is always the possibility of repet
and verification. Upon this consideration rests primarily
confidence in the facts of science; and this, again, is a s
of certainty not possible except in natural science. Histor
proaches more closely to science in its certainty than any
else. A scientific fact is in itself, of course, no more sure
a fact of history, in so far as each rests upon the same evide
and the evidence may become sufficient to establish histor
facts with absolutely convincing force. But we can never re
facts of history; it must depend entirely upon evidence, w
becomes less certain as it becomes less in amount, and co
quently as we get farther away from the facts. Nor can we e
be sure of repeating mental conceptions. We can never k
that we are following another person's thoughts, or that we
putting ourselves into the same mental position which he h
We cannot be certain, then, that we are performing the s
mental processes, and therefore repeating his thoughts.
far, then, as scientific facts depend upon evidence, they have
same force as facts of history. In so far as they imply me
processes in observation, they are open to the same source
personal error as all other mental actions. But when they
by repetition be made a perpetual source of evidence to
individual, and when we realize that they are matters of
vation and not of interpretation, and therefore persona
syncrasies are almost entirely eliminated, we must look
scientific facts as more certain than all others, and, indee
approaching the condition of absolute certainty.

But this is only the beginning of the matter. If science
tented herself with facts her position would be unassailable

worthless. We sometimes hear it said that science should stop with facts, and that it has no right to draw conclusions; but this is plainly both impossible and undesirable. A science made up of facts, no matter how true they might be, would be meaningless. Simple observations, however numerous, no more constitute science than a lot of numbers shaken up in a basket would constitute mathematics. It is only as the facts are classified, as generalizations are made, as inferences are drawn from them, and conclusions reached, that observations begin to have any significance. It is a meaningless fact that the Silurian rocks are under the Devonian, but it becomes pregnant with meaning when we draw the inference that this indicates a relative age of the rocks and fossils in them. It is utterly valueless to us to know that a thousand stones which we have observed fell to the ground, but it is of the utmost importance when we draw from the observations the conclusion that all heavy bodies tend to fall towards the earth, and of even more significance when we conclude that all bodies tend to fall towards each other. In these simple cases the conclusions seem almost included in the observations, but, nevertheless, they are entirely distinct from them; and this serves to illustrate the statement just made, that it is only inferences and conclusions which are of any significance. If, then, science uses its observed facts only as data for inferences, and is itself a collection of deductions, is it any more deserving of credence than other branches of learning? Plainly enough, there is no longer either of the special reasons for acceptance which we have seen giving superior value to scientific facts. The inferences here are just as truly open to the error of the personal equation as they are in any other line of knowledge, and there is primarily no reason for thinking them better drawn in science than elsewhere. Is there, then, any reason for thinking that scientific conclusions are especially deserving of credence, and have a right to the claim which scientists hold for them,—of being the most certain conclusions of knowledge? That the usual answer to this question will be in the affirmative seems quite certain. Scientific conclusions are everywhere received as authoritative. They have driven other branches of learning from many of their positions, and have not in turn been driven. The most serious argument which can be urged against any belief is that it contradicts the conclusions of science, and it

is everywhere recognized that our theological and metaphys beliefs must agree with the accepted conclusions from science

But no sweeping statements can be made. Scientific infere have a very varying degree of probability, ranging from alm certainty to the wildest hypothesis. Proof of an inductive c clusion is an impossibility, for it must not only be shown t the conclusion in question fits all the facts of the past, pres and future, but also that it is the only conclusion that can p sibly be framed to fit the facts. This is a manifest impossib but the approximation to it may be very close. Most pers would regard the circulation of the blood as a demonstra fact, and yet it has never been observed nor absolutely dem strated. It is an inference from observed facts, but an infere so strong that it is utterly impossible to doubt its being the tr From practical certainty like this we may pass by easy stage the wildest hypothesis. The law of gravitation; the theor the long duration of the geological ages; the theory of ev tion; the theory of the spontaneous generation of life, eithe the present time or in the past; the idea of a central sun ar which all the stars in the universe are revolving,—all of th represent inferences from scientific facts, but inferences of a and less degree of cogency of proof, until the last is not more than a poetical speculation. Recognizing thus the var degree of probability, it is plain enough that it is impossib make the general statement that scientific conclusions ar any more value than those from non-scientific thought. N indeed, would our scientists pretend that such a statement c be made, for, however firmly they may believe in the cogen their conclusions, they are fully aware of the possibility of inferences and mistaken theories.

How is it, then, that scientific conclusions can have superior authority? The answer is, because they are, in cases, open to a more or less direct verification, and the with which they appeal to us is directly proportioned to exactness of this verification. It is frequently possible, by pealing to facts of observation (which we have seen are our sure source of information), to render an inference palpably surd, or to show it in most exact accord with all nature. In first place, our scientists are constantly dealing with facts. T begin their training by observation, and for a long time obser

tion occupies almost their sole attention. Many, indeed, get no farther than this, and are little more than observing machines. When they do go outside this line it is always with more or less caution, because they well know that if their inferences be not truths they will soon be disproved. Trained to deal with facts, they are constantly using observation as checks and guides to their speculation, and after any conclusion is reached or any theory made it must meet thousands of unthought-of observations from nature, and be found to fall in with them all in perfect harmony before it can stand as an accepted scientific conclusion. In this they differ from metaphysical or philosophical inferences. If one theologian differs from another, each can think the other mistaken without the possibility of proof, for the necessary facts are beyond their reach, and the different stand-points of the two give, each, a different view. But if one scientist differs from another, it is frequently only a matter of a few years when further collections from nature's store of facts will refute the position of one, or perhaps both. Here, then, there is a possibility of verifying the realm of thought by the realm of fact. Observations are made, and the mind works them over and draws conclusions from them, creating usually a thought to explain them. Then once more it turns to observations to see if the thought created for a few facts will explain all, and thus have the force of a general truth. When Darwin first conceived the theory which afterwards made his name famous, it was from a few observations upon the geographical distribution of animals; but, having conceived a thought which explained these facts, he spent twenty years in patient application of this thought to all other classes of observation, and it was not till he had satisfied himself that the conclusion did harmonize with all the facts which he could collect that he was ready to let it be known. When the theory was finally given to the world its great force was in this very fact, that it was shown to be in such accord with numerous facts of nature; and what prevents it from being universally accepted to-day is that there are still some facts which do not seem in accordance with the theory.

Thus it is with all scientific theories which have any authority. There is always a world of observation to be considered, which must be found in harmony with the conclusions. So cogent do these conclusions sometimes become that they not only enable

us to interpret the present and explain the past, but to predict the future. In every way they may thus be made to show their exact harmony with nature. False inferences cannot be in harmony with this truth, and errors cannot stand. Scientific theories are very abundant, and many of them are wrong, but the world of facts gives an opportunity for examination, dispute, and final rejection of the false ones. This fact, that many theories have been disproved and rejected by those who originally advanced them, is the greatest safeguard of science, for it gives us the greater confidence in such conclusions as retain the universal acceptance of thinkers after long discussion.

In this way it is that scientific conclusions may, under the right conditions, appeal to us with such force. Such a verification is impossible in other branches of learning. There are no similar series of observations which can be brought to testify to the truth of metaphysical or ethical conclusions. Here each conclusion can be attested only by the same sort of evidence which produced it. It is, in all stages, a mental conception, for which there can be no physical evidence. The errors which may have crept into the original inference cannot be removed by contact with reality. The personal equation becomes great, and hopes, desires, loves, and enmities may come in to modify that equation. A person brought up as a Mohammedan believes Mohammedanism beyond dispute, while we are even more confident of the truth of Christian beliefs. Two races of people, if kept separate from each other, might develop different systems of theology, of metaphysics, of art, of morals, because these would depend almost entirely upon the thinker; but the laws of dynamics, the classification of the animal kingdom, would be alike in both cases, for these depend not upon the thinker alone, but are verified by nature.

Assuming, then, the general truthfulness of nature and the validity of mind, there is a general concession that there is a greater certainty possible for scientific inferences than for others. A greater certainty *is possible*, but it does not always exist, nor does it extend to all scientific theories. Because a universally-accepted theory claims so great credence it by no means follows that all science deserves a similar acceptance. Here it is that scientists make their greatest mistake, in failing to separate the positive from the probable and the possible. The conclusion

that the fossils of our rocks were once living animals occupies a very different position from the theory of evolution. One is almost included in the observed facts, while the other implies much more of inference. But too often our writers and teachers fail to separate them, giving equal credence to such theories as the undulatory theory of light and the law of gravitation. This is all very well when scientist is addressing scientist; any amount of imagination and speculation is then admissible. Hypothesis may be assumed as fact, and used as a basis of further conclusion. But a teacher to his students or a writer to the general public should be very careful to distinguish between the positive, the probable, and the possible. He should offer as positive only such conclusions as have placed themselves beyond dispute, and regard all others as more or less probable, according as they have been verified by observation. Unfortunately, many of our teachers, and an even greater number of our writers, fail to do this. They are ready to accept before the public more than is proved, as it is perfectly proper for them to do with each other, and they thus lose the reputation for exactness and unwillingness to accept anything that is not beyond doubt, which should always characterize science.

A scientific fact, then, claims superiority to all else for two reasons,—the necessary belief in the truthfulness of nature, and the possibility of indefinite repetition of experiments and observations. But when we go beyond the facts and draw inferences, there is primarily no more reason for believing in the truth of the inference from science than in any non-scientific inference. Some conclusions can, by a long and successful verification from the facts of nature, be rendered very certain,—more certain, indeed, than any other factor of knowledge. We, then, frequently call them facts, though they are really nothing more than strong inferences. But this does not in the least give any greater probability to other conclusions. The fact that a theory is a scientific theory tells us nothing as to its probability, for there are many conclusions of theology or morals more probable than certain scientific conclusions. It is only after a conclusion has long stood the test of fact, and has shown itself so in harmony with all nature as to be universally accepted, that there can be claimed for it any of that superior weight of authority which is by general consent given to scientific truths.

COMPARATIVE CHEMISTRY OF HIGHER AND LOWER PLANTS.

BY HELEN C. DE S. ABBOTT.

(Concluded from page 730.)

THE laws controlling the chemical evolution of plant-constituents are too little comprehended to formulate, but before reaching a position ever to do this, it will be necessary to study carefully the facts from extended researches, to ascertain how these chemical constituents occur, under what conditions, and if these conditions are constant or variable, and to what may be ascribed the variability.

In speaking of chemical compounds I will describe them as occurring according to the botanical disposition of Heckel's table, which I use provisionally, since it is not probable that this presentation will be the ultimate or best way to introduce the subject. But I am not prepared yet to offer any other arrangement purely on a chemical basis; since the application of the chemical side of plant-life as one more evidence in favor of the hypothesis of evolution, is still too new to possess a literature of its own.

I have already referred to the protoplasm and starch, also to the large ash-percentages of some of the lower groups, and among the compounds commonly found in many plants tannin appears first according to the evolutionary order in liverworts.

Chlorophyll is one of the earliest compounds to appear, and its presence in Algæ and its absence in Fungi is a distinction between the two divisions of the Thallophyta group. Besides this green coloring matter, which is, with few exceptions, common to all plants, other brilliant coloring matters occur in some of these lower plant forms which are peculiar to whole families and correlated with special physiological functions.

The general distribution of chlorophyll, with few exceptions, in all plant groups is only second to the proteid compounds; however, the color of this compound is not the same tint in all plants, and the evergreens and many other plants when compared will be found in this respect distinct. The gradual change from the bright greens of the early spring foliage to the duller greens

of late summer illustrates the transmutation of color which may be observed in plants, and I would suggest that this same gradation may be seen on the large evolutionary planes of all plant groups, chlorophyll, like the plants, being at different evolutionary stages; for example, in many Algæ and lower plants it appears as light bright greens, and finally in the darker greens of the higher plants.

Considering in general the chemical compounds of flowering plants among the apetals and monocotyledons on the first evolutionary plane, where the plant elements are simple, tannin, wax, starch, aromatic or acrid principles, and the oils and sugar of the palm are the most conspicuous substances. These compounds are found in the same or in neighboring plants, and their association is doubtless of evolutionary significance. Glucosides or alkaloids, though occurring in some few of these plants, are not characteristic of this stage of evolution.

Tannin is a general name for a class of substances which presents many aspects in different plants. It first appears, as was stated, in the liverworts, combined with large quantities of starch and wax; then in ferns. Among the amental apetalous groups it is one of the conspicuous compounds, also associated with starch; the casuarina, willow, poplar, hazel, oak, beech, chestnut, alder, and birch containing large quantities. Tannin is widely distributed, though especially in the leaves, barks,[1] seeds, and rinds of fruits, and in other plants in considerable quantities, as the maple, sumach, tea, in many berries, the holly, and the seeds and stalks of the grape-vine.

Tormentilla erecta,[2] Rosaceæ, yields six to twenty per cent tannin, and, although this compound is present in mono- and dicotyledonous plants, it seems to be more prominent in the apetalous on the first evolutionary plane, and to occur less, if at all, in the highest plants. When it is remembered that tannin is found in greater abundance in lower plants, which I have compared as formative to the formed or higher evolutionary groups, it is a still further illustration of what was stated about the higher percentage of ash-constituents in lower plants.

Physiologists differ as to the tannin functions in plants. It

[1] "Repartition du Tannin dans les diverses Regions du Bois de Chene," Ann. de la Science Agr.

[2] Fraas, Ergebnisse, Landw. Versuche, München, 1861.

probably serves several purposes; according to Schell, as a plastic material for the building up of tissues, especially where starch or fats are absent; or it exists as a subordinate product. It is certainly true that some tannins play a distinct rôle as the source of many vegetable colors,—the reds and blues of flowers, the brown of tree-barks, and the colors of changing leaves owing their origin to this source.

The large quantity of starch in most tannin plants is remarkable, and Sachs believes it, or fixed oils, to be the mother-substance of tannin.

Datiscin,[1] a kind of starch, is found in the Datisca order, and among the monocotyledons, the palms occur on the same plane, and in most of their genera contain large quantities of starch, eight hundred pounds of sago having been obtained from one plant of *Metroxylon*, or the sago-palm species. The *Arum pandanus* (screw-pine) and bulrush orders yield much starch; of the latter plants, 12.5 per cent. from *Typha latifolia* (Lecoq).

Large quantities of wax are found in species of the myrtle, and also of the palm.

On the second plane, or multiplicity of floral parts, the chemical constituents become much more numerous at this stage. Under the apetalous and monocotyledonous groups volatile, pungent, and aromatic principles, alkaloids, sugars, coloring-matters, camphors, resins, starch, and glucosides appear prominently. The lower dicotyledonous plants reproduce many of the compounds of the other two classes, for the Rosaceæ contain the tannins of the lower apetalous plants and its parallel groups, and the glucosides of the higher monocotyledons.

Cane-sugar is a prominent compound here. If a horizontal line be drawn from a given point of Heckel's scheme it passes through the apetalous, mono- and dicotyledonous groups, which contain this substance most abundantly,—namely, the sugar-beet, sugar-cane, sorghum, the fruit groups of the Rosaceæ, and the sugar-maple.

The sugar of the palms, among the highest of plants with simplicity of floral elements, is very like that of the cane. Since the grasses are the lower of monocotyledons with multiplicity of parts, it is notable that at the meeting-ground between these groups, or at the transition-stage into multiplicity, sugar should

[1] According to Stenhouse, datiscin is a crystalline glucosidal bitter substance.

occur. The sugar of the palm is very little above the sugar line; it may be considered, in an evolutionary sense, as passing to the cane-sugar of these other groups, and as forming the apex of a low triangle, the base being the sugar line already described. The large percentage of grape-sugar in the fig, *Ficus carica*, occurs in a class very nearly on a line with these cane-sugar plants.

Glucosides are more especially the compounds of the middle plane of plant development, and are found in the higher monocotyledons of this stage, in the lower and some of the higher dicotyledons, and less frequently in the highest of all plants, or under cephalization. The first appearance of a glucoside occurs in the apetalous groups of flowering plants, as quercitrin in *Carya tomentosa*, Juglandaceæ, or in other hickory varieties; then in the next following orders, as salicin and populin, of the willow and poplar; antiarin, of the Antsjar, or Upas-tree (*Antiaris toxicaria*); acorin, of the *Arum;* and coniferin, of the Coniferæ. Among the Lirioideæ groups many glucosides occur, especially saponin, and I have found this compound in species of the yucca, agave, and among dicotyledons in leguminous plants; besides, it is found in Rosæ and other parallel groups.

Saponin is also found in *Smilax*, a genus partaking somewhat of the nature of endogens and exogens, and serves to unite all the saponin groups;[1] and although this compound is widely distributed in plants, it is a significant fact that all the groups containing it belong to this middle evolutionary division.

Rosoll[2] has found saponin in the cell-sap of living roots of *Saponaria* and *Gysophila*, and I have elsewhere called attention to the solvent action of saponin on resins,[3] also on calcium oxalate. This property is of value to the plant not only by acting as a solvent of insoluble or slightly soluble compounds, and thus assisting it in obtaining food otherwise difficult of access, but also resins are found in nearly all the Lirioideæ, and the presence of this chemical class associated with saponin shows a physiological adaptation of importance to the plant. It may be recalled that the pink family is remarkable for its proportion of lime, and this element is frequently found in large quantities,

[1] "Chemical Basis of Plant Forms."

[2] Monatsb. Chem., v. 94; Jahresb. d. Chem., 1884.

[3] *Yucca angustifolia*, Trans. Amer. Phila. Soc.; Chemical Basis of Plant Forms, Jour. Franklin Institute.

as well as resins, in other saponin orders. Saponin may thus be called a constructive element in developing the plant from the multiplicity of floral element to cephalization of these organs.

Among the members of the higher groups of plants many of the preceding stages of chemical evolution are represented up to a certain point, when the plants acquire other chemical characteristics,—*i.e.*, indigo, hæmatoxylin, and other coloring-matters of the leguminous groups, and the dyes of the madder plant, give way to the alkaloids of the cinchona, the coffee, the atropa, and the strychnos orders, and to the organic acids of the valerian order, and the aromatic and volatile compounds of the Compositæ.

Alkaloids, though so widely distributed, are not found in the very lowest nor the highest plants. Their occurrence in fungi has been already noted. In flowering plants among the lower apetals, piperin, the alkaloid of Piperaceæ, occurs; also, alkaloids are found in the monimia, hemp, laurel, and amaryllis orders, and in colchicum; but they are exceptional in these lower groups, and belong properly to dicotyledons, where they are found in many orders.

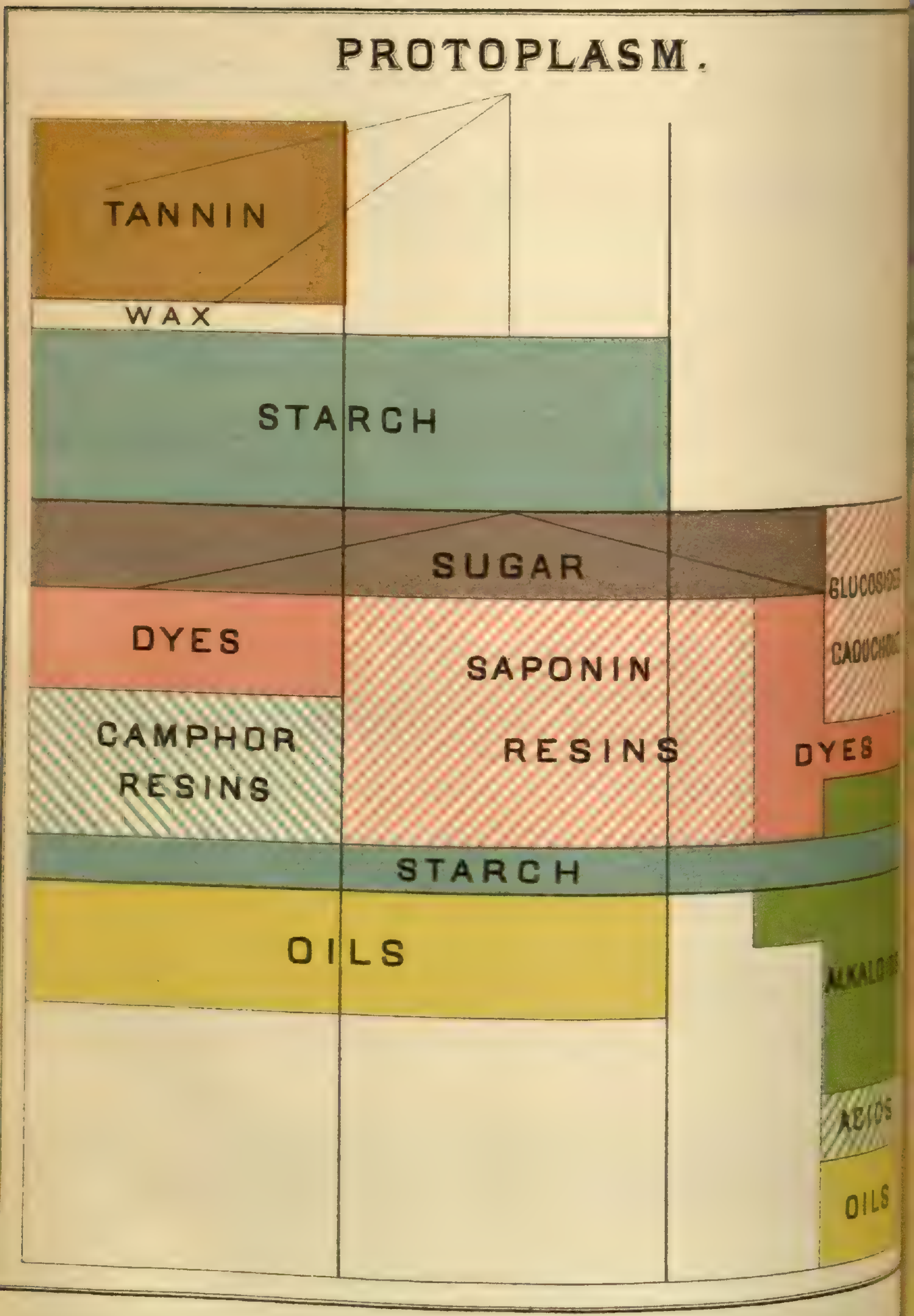
Besides the occurrence of compounds peculiar to distinct plants or whole plant groups, another class is found, and the substances of this class may be scattered quite generally through the plant kingdom, but always associated with some other compound.

Coumarin, the odorous principle of tonka-bean and vernal grass, is one illustration; its occurrence is limited to those plants containing oils, and, since in many genera in which this substance has been found certain fixed or ethereal oils also occur, it may be inferred that this constancy relates to their chemical evolution. The palms are the lowest plants which contain coumarin; then it occurs in the grass and rose families on the same evolutionary plane, also among the leguminous, madder, rue, and portulaca orders, and in orchids and Compositæ. These plants are characterized by their aromatic and volatile oily products; and vanillin, the fragrant principle of vanilla, also occurs among orchids. It may be noted that oils are formed abundantly in the highest plants.

A knowledge of the chemical compounds, as they are found grouped in plants, is a first step towards the study of their evo-

PLATE XXVII.

Plate II.



lution, and acquaintance with the conditions which control their synthesis and gradual formation in the plant can only be had by patient research. The simpler compounds of which any complex substance is built, if located as compounds of lower plants, would indicate the lines of progression from the lower to the higher groups.

It has been already said that every plant contains compounds peculiar to it, but certain compounds seem to play a special part in plant evolution, since the wax and tannin of the vascular cryptogams lead to the tannin and wax groups of the apetalous plants, and the starch of these lower plants to the great starch groups of the monocotyledonous. It will not be out of place to note here that the greatest accumulations of starch occur in plant orders just before they pass on to a higher plane of evolution. This is seen, for example, in the palm and neighboring orders of the first plane, and among the Lirioideæ of the second plane, since these plants are the richest in starch constituents, and it seems as if they were preparing by large reserves of food-supply for their higher position, represented by more evolved groups, where the demands for nutrition are greater. Again, the line of cane-sugar indicates that sugar occurs prominently in plants passing from simplicity to multiplicity of floral elements, and the glucosides in their turn are found in the middle stage of plant development, assisting the plants to the highest plane of cephalization.

Plate XXVII. is a chemical representation, drawn after Heckel's botanical table, and from what has preceded it will be easily comprehended. It is not to be inferred that all classes of chemical compounds found in plants are represented, since only a few have been used for illustration, nor that all of these given compounds only occur in the designated plant groups, since they may occur in traces or varying quantities elsewhere. However, these compounds are conspicuous as being especially typical of the plant groups which correspond to their location, and where their presence is doubtless associated with the plants' evolution.

The chemical compounds which may be said to be typical of an order, species, or an individual member of a series would be out of place in this general presentation.

Some plant groups, as the Proteaceæ, orchids, and Compositæ, develop in æsthetic beauty at the expense of their chemical con-

stituents, all resources go to develop the perfection of the flower and the absence of numerous compounds in these plants is a strong point in favor of chemical evolution favoring plant development. These beautiful plants being among the highest of their series, may well be called the aristocrats of the vegetable kingdom.

It is still impossible to demonstrate the full significance of this chemical theory in plant development, but it will be evident to any one who examines botanical and chemical facts that the presence of certain chemical compounds is associated with certain botanical conditions, and where these conditions are variable is found a like variability of chemical composition. If it can be proved that chemical and botanical morphology are not one and the same, at least the two are very intimately correlated.

It has been said that many of the constituents found in plants are the result of destructive metabolism, and are of no further use in the plant's economy, but our knowledge of what constitute plastic and waste products is by no means settled, and even should we be forced to accept the conclusion that some products are of no use to the plant, yet it is a significant fact that certain cell-tissues or organs secrete or excrete chemical compounds peculiar to them, and which are only to be found in one family or in species closely allied to it.

Broadly speaking, the study of plant-life cannot be confined within the limits of the vegetable-cell, since its radiations reach to the domains of mineralogy and animal life. From a chemical point alone it would be difficult to discriminate in every case between the plant- and animal-cell. The series of animal-gums, carbo-hydrates, alkaloids, and coloring-matters find their analogous series in plants; by the study of embryology it is found that alantoin occurs in animal- and plant-life, also glycogen and inosite are found in both kingdoms, and the secretion of some plant-leaves is a fluid chemically like the animal gastric juice.

M. Leo Errera,[1] in a recent paper on a fundamental condition of equilibrium of living cells, calls attention to the thin and plastic condition of plant- as well as animal-cells at the moment of their formation, and their tendency to assume a form which, under the same conditions, an imponderable lamina of liquid would take, and he attributes to this fact their adaptability and the facility

[1] Comp. Rend., t. xiii., 1886, p. 822.

with which they change. He believes that we can trace to this cause the great number of organic forms, and for the first time unite the architecture of the cell to molecular physics. Only with age the cell-membrane becomes thick and offers a considerable resistance.

It may be suggested that this fact is further exhibited when applied to the conditions obtained when plants pass from their younger to older stages; again, it is seen on comparing the lower plastic protoplasmic plants with the rigidity and firmness of the tissues of the higher plants, and in the change from the semi-fluid to the formed and fixed states of chemical compounds.

The law of progression is one that regards the general good to the disregard of the individual; since in the death or fixation and crystallization of individuals the vegetable kingdom, on the whole, has ascended to its highest present living form, and many of its constituent chemical parts had long ago reached their pinnacle in the cycle of evolution. This concerns equally the changes in the vegetable-cell, and its complex molecule of proteid is built from simple substances, which in turn break down into less complex bodies, and are again reconstructed into proteids, or as cellulose and other compounds remain as the component parts of tissue in higher plants, thus serving the mechanical and physiological needs of the organism.

Aside from the practical application of plant products to dietetics, pharmacy, and the industries, it is eminently for purposes of scientific investigation that the field of plant chemistry is most promising.

It has been suggested to me from botanical sources that time will be unwisely expended over a detailed study of the chemical compounds of plants; in this, as in mineralogy, its use as a means of classification will depend upon the convictions of the investigator, although it seems to me that many of the vexed questions of plant development can only be solved by a full comprehension of vegetable chemistry.

It is not to be inferred that "botanists," the knights of morphology and systematic classification, will thereby be deprived, by chemists, from tilting over the floral tournament courts. Perhaps in such pleasant pastimes of contest for disputed plant groups this veteran army of knights-errant may at least become weary, and willingly exchange the lance for the balance.

The vegetable kingdom is so vast that the botanico-chemical facts at our disposal are meagre in comparison to the data required, and in consequence many of the explanatory statements advanced can only be considered in the light of speculation. Vistas have opened most promisingly but to be cut off suddenly by a limitation of these details, and I cannot urge too strongly the very great importance of minute chemical research at least in certain typical members of botanical groups; without such investigation a great deal of our present knowledge is worthless. The changes of the chemical compounds within the cell, the simultaneous appearance of two or more compounds always in association, and the predominance of some one compound in certain plant groups, should be seriously considered before the evolution of plant chemistry be definitely approved or condemned. These facts suggest questions which must be answered before a further advance can be made in plant biology.

The practical application of a theory, which advocates that the morphology of a plant is the outcome of its chemistry, will be used by the chemist to direct him to certain plant groups for any compound which experience proves to be present with similar morphological characters in other groups.

It has been recently suggested[1] that many of the chemical compounds may serve the plant as means of defence against animals, and when we camphorize our furniture and poison our flower-beds, we are only imitating and reinventing what the plants practised before the existence of man; and I may add that the cinchona-tree of malarial countries proclaimed long since their subtle therapeutical skill in securing for themselves a corner in quinine manufacture, independent of contemporary sources.

A full acquaintance with the chemical compounds of living plant orders may even lead to a chemistry of paleo-botany, and where the fossil forms resemble modern groups, as in some of the well-preserved remains lately discovered in France,[2] the same chemical compounds might have existed as are now found in similar groups. From the knowledge which will one day be ours of the morphology and evolution of chemical substances a flora may be reconstructed reaching far back into the recesses of time.

[1] M. Léo. Errera, Royal Bot. Soc. of Belgium, Revue Scien., 29th Jan., 1887.
[2] M. Louis Crié, Comp. Rend., t. ciii. p. 1143.

In minerals, plants, and animals the same principles recur, though at each higher plane under more complicated conditions; and any one who, on visiting the Hot Springs of the Yellowstone National Park, has seen the non-carboniferous gelatinous masses assuming the forms of organized life will ask himself if silica, under some conditions, may not replace carbon and become living matter. Since Confervæ do live in these springs at high temperature, perhaps some such locality as the Yellowstone may have been the birthplace of "a protoplasmic primordial atomic globule."

The impulse which directs minerals to masquerade as living plants and animals often manifests itself, for example, in the ferns called stag-horns; and orchids, disguised like insects, pretend to be what they are not. When will all of these intricacies of nature's secrets belong to commonplace facts? The day is distant. And in the mean time my hour is drawing to a close; and, to return to my first statement of the evolution of the chemical elements, I would say that the studies[1] of Lecoq de Boisbaudron, Auer, Demarçay, and Crookes on didymium, and the latter's researches on yttria, and more recently on the crimson line of phosphorescent alumina,[2] go to show that the molecules of these so-called elements are compound, and if I have dwelt at all upon this subject, in connection with plant-life, it is on account of the indisputably serious nature of the investigations in this field. On listening to the following concluding remarks of Professor Crookes's address[3] the chemical evolution of plant compounds receives an able ally. He says, "We cannot venture to assert positively that our so-called elements have been evolved from one primordial matter, but we may contend that the balance of evidence . . . fairly weighs in favor of this speculation. . . . The doctrine of evolution, as you well know, has thrown a new light upon and given a new impulse to every department of biology, leading us, may we not hope, to anticipate a corresponding wakening light in the domain of chemistry. I would ask investigators not necessarily either to accept or reject the hypothesis of chemical evolution, but to treat it as a provisional hypothesis; keep it in view in their researches, to inquire how

[1] Comp. Rend., t. civ., 1887, p. 165, M. Henri Besquerel.
[2] Chem. News, Jan. 21, 1887.
[3] Delivered before the British A. A. S., 1886.

far it lends itself to the interpretation of the phenomena observed, and to test experimentally every line of thought which points in this direction."

From the above sketch I have attempted to show that the hypothesis of evolution may also apply to the chemistry of plant compounds, and that plant chemistry will be found, like any special study, to include many others. It is, however, exceptional in its broad range, and the variety of its topics, like the variations of flower-species, may be cultivated to suit the taste of the investigator.

INSTRUCTION IN GEOLOGICAL INVESTIGATION.

BY WILLIAM MORRIS DAVIS.

Revised from a paper read before the Association of American Naturalists in Philadelphia, December, 1886.

INSTRUCTION in geological investigation is so new a department of teaching that it is little assisted or hampered by traditional methods. Its best materials are found in the wide out-door laboratory, and as all out-door laboratories are of their own local kind, every teacher is required to develop his own methods of using them; and he must count this to his advantage, for it prevents him from doing his own work in some other person's way. The personality of the teacher must appear here if anywhere; and it must be strongly flavored with the local problems that spring up around him in new crops every year, and with his own methods of attacking them. Instruction in geological investigation at any one place cannot therefore hope to reach the completeness that may be attained in physics or chemistry, where experiments are made to order in-doors, limited rather by the funds than by the place of the laboratory. Consequently, one of the first aims of the instructor, and of the student too if he take a proper share in laying out his own course of work, should be to see that his geological studies are pursued under more than one teacher and in many more than one place. So distinct is this need, and so strong do I feel the limitations that determine it, that I shall not presume to talk up to the general title suggested by the committee in charge of our meeting, but shall at

once make my statements specific and tell you little more than my own plan and practice of instruction in this broad subject. Neither plan nor practice has much age to recommend it; both vary, to their improvement I trust, from year to year; and it should be explained at the beginning that my experience does not reach to either one of two branches of geological study that occupy much attention,—palæontology and petrography: there is enough to begin with in structural and physical geology.

Investigation begins with learning to see for oneself. The first teaching in geological investigation should therefore be made early in the course of study, and not postponed so that only advanced students and specialists can reach it. College sophomores, having had a general lecture course on geology in their freshman year, are well prepared for the first steps; but they are truly first steps that are then taken, for the face of the country has no expression to young men who have indeed learned what is considered the saving quantity of classics, mathematics or history, but who are unpractised in observation; their eyes are not yet opened to the sight of the land about them. Sometimes, to be sure, a student comes bringing with him the popular impression that he is something of a geologist because he can give the specific names of a number of minerals and fossils, learned in a cabinet; and he may be excused for thinking so, for does not every geologist meet, during his summer travels, the embarrassing necessity of simulating an interest in the kind attentions of his host who wishes to exhibit some "curious mineral" or "fossil footprint," as if the geological attractions of the neighborhood centred therein? The mental philosophy of geology is still an unopened book even to intelligent people. Naturally enough, therefore, the student, who has imbibed the popular conception of the study, or who has learned only from books and lectures a series of verbal definitions and explanations, comes to a full stop on being told that he is to discover for himself and from his own observation the correlation and sequence of geological phenomena in the district around him. The fundamental difficulty that he feels is the inability to see what he looks at. When this difficulty is fairly overcome, the gain that he has made is of so great value in his general as well as in his geological education that I find in this very fact the warrant for the election of the study of field geology by many more young men than the

few who may intend to follow the subject professionally in later years. Let us consider an actual case. The first excursion that I commonly take with a class leads us to an old quarry in Somerville, near the Agassiz Museum in Cambridge, where a large dike some forty feet wide, cuts across the beds of the Somerville slates. There may be ten or twenty students in the party, and it should be remembered that they have had a preliminary course in elementary geology, in which nearly all the terms that we have occasion to use have been defined: they are also provided with hammers, compasses, clinometers, note-books, and outline maps of the district. On entering the quarry, I select two fragments of rock: one exhibits a fine, granular texture, with bands of alternating color, and is shown as the type of a bedded, stratified or aqueous rock; the other is of crystalline texture, without arrangement in layers, and represents the group of massive, crystalline, or igneous rocks; and without further explanation than this, the students are asked to search out the area occupied by each rock, the line of contact and the phenomena exhibited along it, and to determine the relations of the two and the sequence of events in their history. Emphasis is given to the importance of personal work, and I take pains to say how much more valuable is the ability to determine the facts than the facts themselves. For several years it was my practice to point out the quarry-structure on the first excursion, thinking it too difficult for beginners to discover; but it seems now that that was almost a waste of time. It must be borne in mind that the students who are set to this work have already had in their preliminary course some account of just such facts as they now encounter in the field; they do not come to the task unprepared. Moreover, the attention of the class is not so well held by explanation from an instructor as by exploration for themselves. I therefore throw them at once on their difficulties; my own endeavor being rather to suggest observations and give encouragement than to answer questions. The questions are to be answered by the rocks. Even the best students are almost helpless at first,—so little has their general education taught them of independent, original observation even of a simple kind. One of the commonest statements is, "I don't know how to go to work," upon which it is necessary to repeat that the first step is simply to search out the area of the two rocks and the phenomena of their line of con-

tact. Not knowing how to go to work on such a problem does not mean ignorance of geology alone, but inexperience in the first requisite of scientific study. But the most characteristic feature of the first day's work is the frequency with which the instructor's authority is appealed to in decision of questions that lie open before the class. It is as if the weight of previous education were thrown on the side of dulling individual observation and judgment. It requires much care to avoid answering easy questions and thus defeating the objects of the excursion; and it requires more care to escape answering the questions without either discouraging or exasperating the questioners. A preliminary explanation is advisable, so that all may understand that there is nothing like a rebuff intended in the rather brusque counter-questions that serve best to direct the work where it should go. A student will sometimes come up to me, after a very insufficient search for facts on the ground, and, presenting a piece of the dike, say, with the idea that he is doing his full duty, "Isn't this melaphyr?" Now, as a matter of fact, he is, in this particular case, quite right; at least, so I am assured by competent lithologists, and later on he should be told so, but not at first. He has perhaps heard the name, melaphyr, associated with dark-colored, fine-grained rocks, and makes a lucky venture in using it; but as the object of the work is to train his observation, not mine, I throw the burden of proof upon him by asking in return, "Why do you think so?" "It looks like it." "What is melaphyr?" This may sound, as I now read it, very much like snubbing a praiseworthy inquiry; but see the result. Nine times out of ten the student says, "Oh, melaphyr? Melaphyr is—— I don't remember;" and this clears away the false knowledge that places names uppermost, and brings us down to a solid foundation for good work. No words must be used that cannot be defined: no suggestions must be made that cannot be justified by actual observation. The question may now be returned, "If you cannot say that this is melaphyr, what can you say about it?" "Well, it is a dike." "Why do you think so?" "It looks like one." "What is a dike?" "A dike is a mass of igneous rock filling a fracture in the country-rock." "Does this igneous rock fill such a fracture?" Again it appears how much easier it is to make assertions than to defend them; it is very seldom that a student will on his first endeavor suggest and ap-

ply the tests that furnish him with answers to such questions as these. He must make a second and a third attack before he really gets possession of all the facts about the dike,—its width, dip, and direction; the detail of its contact phenomena; its texture and its joints; but by persevering attention all these facts can be discovered from his own seeing, and then a good lesson is learned. A few such lessons correct the habit of using words recklessly, of making guesses and of offering unjustifiable suggestions in explanation of discovered facts. All this is very elementary; but it is the only basis for good work of a higher order. The better students take to the work with fine spirit; in some cases the opening of their eyes, the awakening of the consciousness that the work is in their hands and that they are really able to undertake it, is an inspiring experience to the instructor,—one that serves to carry him over the disappointment occasioned by the obdurate youths who insist that they, who have most to learn, cannot learn anything from the quarry before them. It is indeed a real pleasure to go with an appreciative new-comer to an old, familiar field and watch his rapid learning of new facts and methods: it is this that saves teaching from becoming monotonous, and makes it instead a very live work.

It is not always easy to secure a good conception of the truth and actuality of phenomena that are named and talked about familiarly enough; for example, the intrusion of the dike that has just been discovered. Some little commonplace detail is then an aid. I suggest that a certain part of the edge of the dike in question be examined minutely and drawn to scale, and that an explanation be sought for the forms thus discovered. A hinged fragment (Fig. 1) is soon found, but its full significance is seldom seen at first. It is part of a "stringer" between two joints which the intruding dike first opened (Fig. 2), the other part having been broken off and carried away out of sight in the further widening of the fracture. The penetration of the dense dike-matter into the narrowest

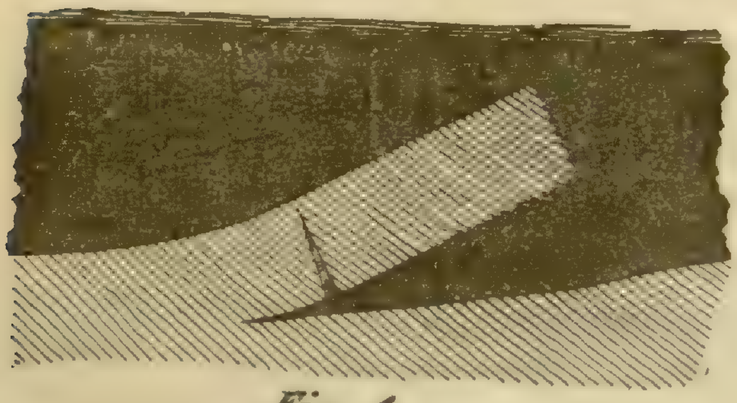


Fig 1.

parts of the crevices thus opened shows how mobile it was under the heat and pressure that caused its motion. This specific detail carries the observer back to the time of the intrusion, and gives reality to it.

A cross-section of the quarry is then asked for, and this brings up a very common difficulty arising from lack of practical geometrical knowledge. The same difficulty appears in determining the dip of the dike; it is as if the rocks were to be studied only in the two dimensions of length and breadth, without the third dimension of thickness or depth. Even so simple a geometrical matter as strike has generally to be labored over. The cross-section of the dike and slate is drawn to estimated scale with some care (Fig. 3) so as to make a beginning at least of correct under-ground interpretation, on which so much advanced work depends; and this leads to many new questions: Did the dike tilt the slate? Did the dike cause the variation in the dip of the slate? Did the dike appear before or after the slate was tilted?

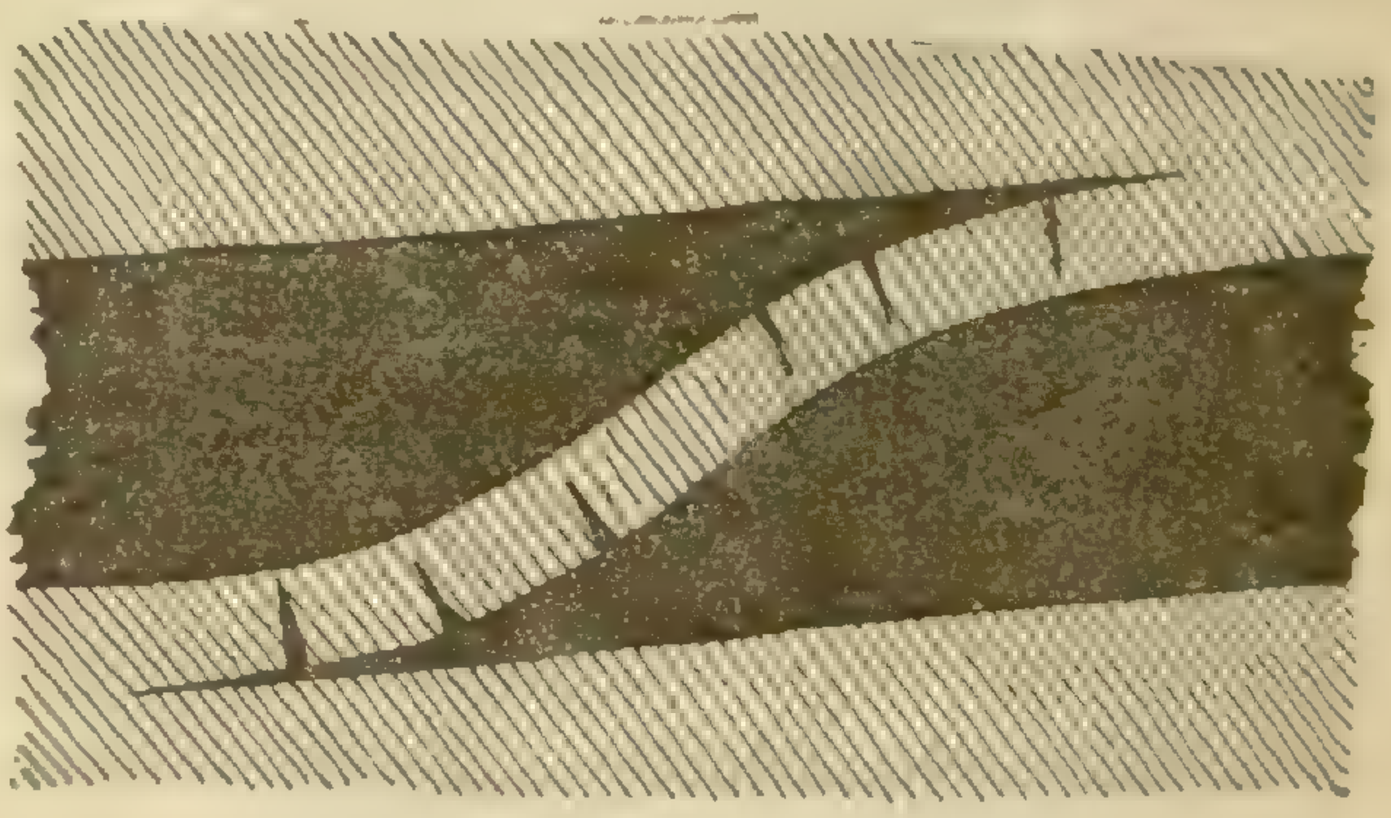


Fig 2.

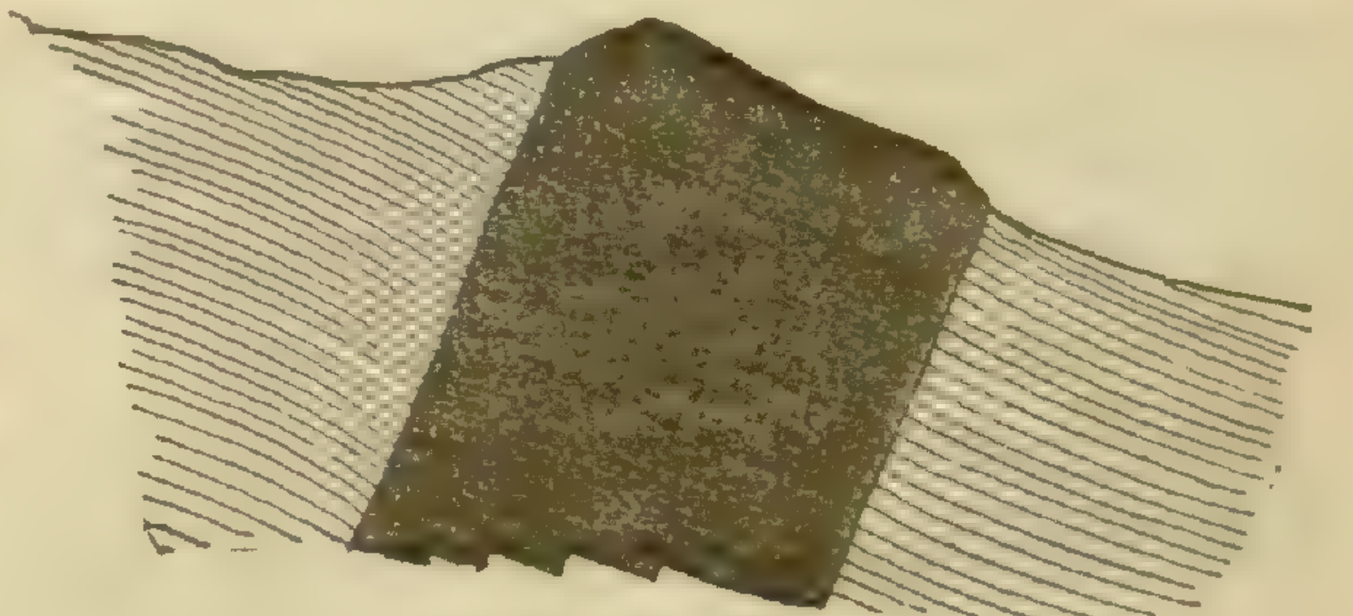


Fig 3

Such questions as these appear utterly obscure and unanswerable to many students: not because they have had no practice in geological investigation, but because they are unpractised in investigation itself. The relation of observation, hypothesis, and verification has not been unfolded to their minds, and it is for this reason that I lay so much stress both here and in the field on the importance of reasoning, as well as of observation, in geological work. Nothing is more important than for the student to perceive that he may discover and follow the legitimate sequence

of argument on which geological assertion is based. Practice in solving the questions proposed above leads to this desirable end. If the dike tilted the slate, the beds should dip away from the dike on both sides, as in Fig. 4. They do not, and it is therefore concluded that the slate was tilted by some force independent of the dikes. This is soon confirmed by finding that the dip of the slate is maintained at a tolerably even angle for a mile

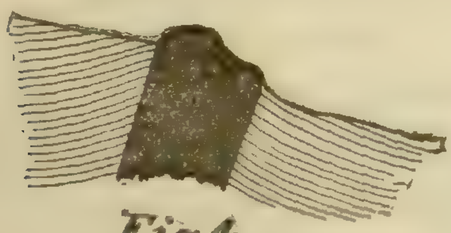


Fig. 4

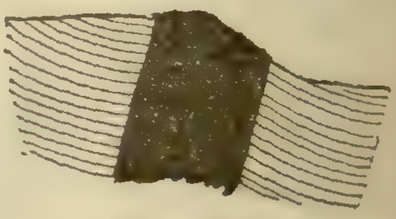


Fig. 5

or more, although intersected in various directions by many dikes. If the dike caused the local irregularity in the dip of the slate, the dip should be increased on the south and decreased on the north, as in Fig. 5; but the observed section in Fig. 3 shows a local increase of dip on both sides of the dike, as if the mass had been slightly sheared independently of the intrusion. Other dikes soon confirm the conclusion that their intrusion did not perceptibly affect the dip of the adjoining beds. In deciding the relation between the dates of intrusion and tilting, we must first rule out any argument based on the present tilted attitude of the dike; it may have been vertical originally and then tilted bodily with the slate to its present dip, or it may have been intruded at its present inclination; therefore no conclusion can be drawn from its dip. The only means here available for reaching an answer depend on a postulate concerning the joints in the slate. The joints *may* have been made in the slate before it was tilted, but they were almost surely made while the tilting was going on. Now, the dike is seen to have smooth joint-faces for the greater part of its walls; it must therefore have taken advantage of pre-existent joints in opening a way for its upward escape, otherwise its edge would be ragged. The dike therefore certainly came after the joints were made, and probably after the tilting was begun. The want of complete decision in this case is not considered reason for omitting its consideration. So much of geological reasoning leads only to probabilities that the student may as well make early acquaintance with this kind of half-way

demonstration, but great care must be taken to see that he fully recognizes the postulates of the argument and does not overdraw on their certainty. The desire for final settlement of all questions is strong in the student mind; questions that must be held open for further investigation are not always favorites, but I believe they are aids to the habit of mental deliberation.

In this particular case the doubt is soon lessened, for a little later, on the same excursion, a ragged dike is found breaking its way unevenly through the slate. The slate is jointed now, and traversed by smooth-walled dikes, showing that the irregularity of the ragged dike is due not to the impossibility of smooth breaks being made in the country-rock, but to their absence at the time of its intrusion. Finally, a smooth dike is found intersecting a ragged dike, giving new and safe evidence of the relatively early and late dates of their respective intrusions; and this is emphasized as a good illustration of a double approach to a single conclusion.

One of the most important exercises in connection with the field-work is the careful formulation, oral and written, of the conclusions reached and the means of reaching them. It helps to do away with the idea that a geologist is a collector of specimens rather than a collector of facts and arguments; it is good mental practice, and aids the student in any kind of work he may afterwards undertake; it is to most of the class the greatest profit that they carry from their excursions.

One of the most instructive quarries in Somerville is roughly drawn in Fig. 6. The attempt is here made to show the visible and covered rock areas, but it should be remembered that the visible rock is much less distinct in the dusty quarry than in the diagram. The tilted slates, S, S, are intersected by a forty-foot dike, AB, and both are cut by a double dike, CD, of moderate thickness. The large dike is soon seen to be horizontally faulted, and the question is put, When and where was it dislocated? the first answer generally refers the time and place to the newer dike, but careful search shows this to be wrong: the great slab of country-rock, which here separates the younger dike into two parts, is found to match the wall from which it was broken; it consists of slate opposite the slate wall, and of old-dike rock opposite the old dike. The newer dike therefore opened its way without any lateral shift of its walls. This is confirmed by

noticing a bend in the dike in the southern part of the quarry the result of a crook in the fracture through which it rose: if there had been shearing motion on the fracture, the width of the

Fig 6.

dike at the crook would have been increased or decreased, as in Fig. 7, *b*, *c*. The faulting of the large dike is thus shown to be independent of and to the west of the fractures occupied by the smaller one. Attention is now turned to a slickensided joint-

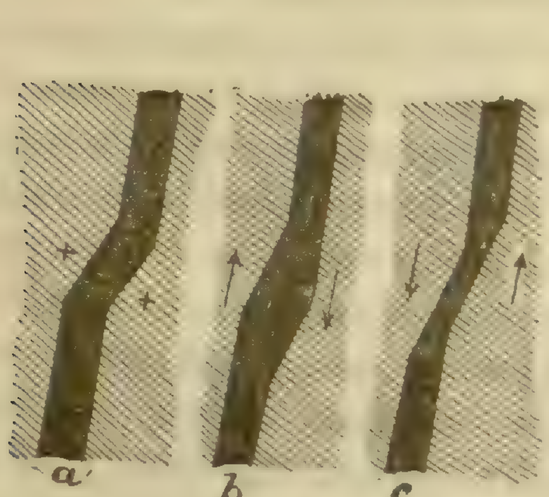


Fig 7

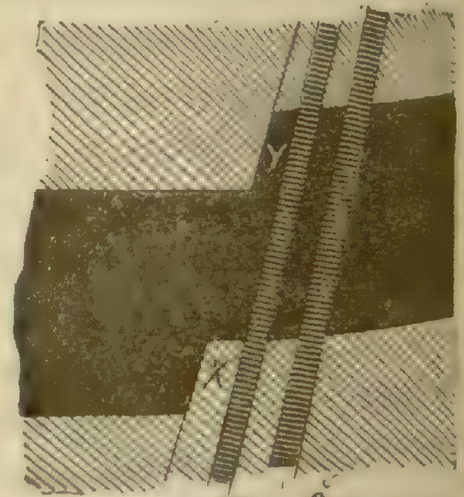


Fig 8

face, EF, Fig. 6, on which breccia and fault-scratches are common: perhaps the faulting occurred here; if so, how can it be demonstrated? Before looking again at the quarry every student

is asked to consider two simple alternatives; the large dike either was or was not moved on this fault-plane: what would be the consequence in either case? what test may be invented to settle the question? If the dike were not moved on this fault-plane (that is, if the dike were younger than the fault), its margins would be in line with each other on both sides of the fault; if the dike were moved on the fault-plane, its north and south margins would be offset, and both by the same amount. The shaded areas marked X, Y, Fig. 8, are thus seen to be of critical importance. If X consist of dike-rock and Y of slate, then the first alternative is true; if X be of slate and Y of dike-rock, then the second alternative is true. Especial attention is called to this deductive method of planning out lines of work. It is not sufficient simply to go out-doors and look about; the geologist must look first, then think, infer, plan, and at last lead his observations to the precise spot where they will do the most good; not the most good to the theory that may from some accident have secured his preference, but the most good in deciding critically among all the possibilities of the case. I think the history of geology need not be read far before one finds unfortunate examples of the neglect of this method. A fact is noted and a suggestion offered: the suggestion fits, and therefore it is accepted. But the student must be made to see that such a method will not lead to safe conclusions. It is quite possible that several processes may bring about the (apparently) same result. In such case it is manifestly unsafe to conclude that any one process did bring about the result merely because it could. Independent evidence must be found to check and confirm a suggested process after its suggestion before any confidence should be placed in it; further, all other apparently possible processes must be ruled out before any one can be accepted as the true and actual one. It is not easy to teach this to a class, and many will slip through the work without much appreciation of it.

Sequence of events, as constituting a portion of geological history, is a matter of importance. The case just described concludes with an illustration of it. The large dike was faulted after the intrusion of the smaller one, for on tracing the fault-plane to the northern side of the quarry, it is found to intersect the western member of the double dike, and brecciate it as well as the other rocks.

The numerous intersecting and faulted dikes on our sea-coast north of Boston present unexcelled examples for work of this kind: the amygdaloid in Brighton and its banded amygdules offer an instructive problem: but the phenomena of the drift are, as a rule, too complicated for local elementary treatment by the methods described above. Their observation needs to be supplemented by many facts drawn from larger fields than our excursions cover, and, although very interesting and valuable for class-work, they cannot be considered as useful in early teaching. Eight excursions of from four to six hours each, four in the fall and four in the spring, are thus occupied, and constitute the field-work that makes one-third part of our second course in geology. They are arranged so as to include as varied examples of structure and as varied problems as possible, but their aim is discovery and demonstration rather than exposition and illustration. They are intended to practise the power of observation, to awaken and develop the methods of geological reasoning, rather than merely to load the memory or inform the mind. Indeed, all this work is like exercise in a gymnasium. A young man who practises leaping over a vaulting-horse does not do so because he expects to meet the same vaulting-horse in after-life, but because he wishes to be able to leap over various obstacles outside of the gymnasium.

The winter season, when out-door work is stopped, can be well employed in securing some familiarity with our geological literature. Government and State reports with Prime's index thereto, the *American Journal of Science*, and the Royal Society's catalogue of scientific papers, with the more important journals that it leads to, are our chief materials, but of this I will not speak further.

At the end of the second course with its field-work, the student must consider carefully if he wish to go farther into geology. If he decide to go on, there are courses in lithology, economic geology, and palæontology before him, but these do not come strictly under the title of my essay. There is also a course in more advanced field-work, which is more to the present point. We find it difficult to give this course as it should be given, on account of its necessary conflict with other college duties. It is impossible to do much serious work without a whole day in the field, and this generally involves the unsatisfactory necessity of

"cutting" something else. The summer vacation may be utilized, but the student is not often well enough prepared to walk alone amidst the complication of problems that he meets. The summer school is a valued factor here, but this is a rather heavy tax on the instructor. We make the best of it in one way or another, and have succeeded in accomplishing some fairly good work; but in contemplating our moderate successes, and comparing them with the more finished products of the biological, chemical, and physical laboratories, we have occasion to lament the unwieldy character of geological problems. The biologist may cultivate his specimens in a jar, slice them nicely in his microtome, and examine them with his microscope, all comfortably arranged at a convenient table in a good light. Winter and summer, good weather and bad, his work of actual and original observation may go on. The geologist has no such good fortune. He must go out of town to his work, spending valuable time on the way there and back. In our present almost mapless condition he has to play topographer to the distraction of his attention, and his problems seldom, if ever, can have the conciseness or the singleness that may characterize work on animals and plants, and which is so desirable for the sake of the student. It is difficult to assign subjects or fields that allow of tolerably complete consideration by a student in the fall and spring half-years. The course in field-work cannot therefore be described with the definiteness given to the more elementary teaching. I can do little more than recount its objects.

The prime object of this advanced work is to teach the student not only to see for himself, but to see for himself when he is alone. In the first field course, where the instructor always accompanies the class, he may direct or suggest a profitable line of work, and hedge the party in from useless searching. It is very different when the student goes out most of the time alone, the instructor accompanying him only on preliminary and occasional later trips. It may be counted a good year's work if the student learn in that time to make an accurate, tolerably complete, and original report, written and graphic, on two areas assigned to him. The want of good topographic base-maps is a serious obstacle here; for the present we have to get along as well as may be with small-scale road-maps, on which the relief of the ground has practically no representation. The topo-

graphic survey of Massachusetts will, however, soon in part remedy this difficulty. The first questions that arise in the field concern the division of the country into its kinds; that is, simple areal geology. As all of our region is largely drift-covered, it is necessary for good work to map the rocks only where they are seen in outcrops, and to classify the drift as well as the rocks beneath it. The number of formations and sub-formations has to be discussed; the characteristics of all to be determined; and the boundaries to be marked out. This is so large a problem, and is often so complicated, that for the first two or three excursions the student may feel discouraged. The best scholars learn much by working out their own difficulties, with no more aid than is given by answers to admissible questions; those with less ability and perseverance need more immediate assistance. Repeated visits to the more significant localities are advised; for the beginner can hardly hope to reach at once the ambition of the most experienced geologist, and see in a first and single view not only the raw facts as they then appear, but also the critical points that are visible only after reflection. There are indeed few fields that do not repay second and third gleanings; if they seem barren after the first harvest, the gleaner had best ascribe the barrenness to his own want of skill.

There are two matters that I find need repeated mention in this work. First, the student must as far as possible finish his work as he goes, and not depend on later visits for doing what he can see on the first; a general reconnoissance is, of course, allowable, but unrecorded or sketchy work must not continue long. Each day's work must show a portion of the map finished as far as the knowledge then possessed will allow; however carefully this is done, there will be enough work for review suggested by later discoveries, and quite out of sight at first. The second matter is the need of distinguishing explicitly between what is seen and what is inferred. Printed maps generally omit this distinction on account of the large scale that it requires, but its omission on field-maps is inexcusable. Strong colors or full lines may be used to indicate well-ascertained facts; faint or dotted colors, and broken or dotted lines, aided by interrogation-points, will signify doubt. Uncolored portions of a final map should mean only unvisited country. A piece of country carefully surveyed and mapped in this way gives good exer-

cise, I believe, to the conscience as well as to the observing faculty.

Innumerable problems arise during this work: they are only too plentiful. The quality of the student may be finely gauged by the kind of questions they excite in him; it is needless to add that the quality of the instructor may be gauged by his answers! As a general rule, the answers should be like guide-boards pointing out the way to the settlement; not like coaches, carrying the passive questioner there: the working geologist must learn to go afoot, and to find his road rather than be led along it. I may be allowed in closing a single illustration from an actual case.

The problem in hand was concerning the former higher level of the sea about Boston. The opinion is commonly entertained that there was a post-glacial depression of the land amounting to about ninety feet; this being quoted from an old record of sea-shells found at that altitude near Winthrop, and confirmed by comparable records to the north and south. If such a depression occurred, the shore of the sea must have run around the margin of the present Boston basin. With this beginning, the student is sent into the field, to search the slopes up to one hundred feet for water-marks, and to search his mind for argument on the whole question. He must be on the alert to perceive any faint indication of a rock-cliff, sand-bar, or delta; he must keep his mind wide open to all available hypotheses for their explanation, even the most "cranky" being dismissed only for cause, not because it is unfashionably dressed; he must be strictly logical and impartial in applying tests to verify his hypotheses, and he must give up all that are found wanting. To the first view, the tramping over the country may seem the greater part of the field-work, but, to one who is able to take the full profit from it, the mental exercise is always much greater than the physical. Some students find the physical work the harder of the two.

The discussion will run about as follows: Admitting that the Winthrop shells are a true sea-deposit, there ought to be signs of an old sea-shore somewhere above the present level, unless the shore did not stand at any level long enough to make a recognizable mark, or unless the Boston basin was mostly occupied by glacial ice during the depression. Supposing that a shore-mark was made, what would be its appearance? The topography of the present shore-line has to be consulted, and

there one finds cliffs and benches, bars, marshes, and delta
The first notable characteristic of these varied forms is that th
stand almost at a single level, the bars being higher than th
benches; the second is that they are arranged in close accor
ance with the general form of the surrounding country: a sea
cliff appears on an exposed headland, not at the end of
crooked, narrow inlet; a bar is strung along from a cliff-bend
and adjacent bars are sympathetic in their attitude; deltas ar
found only opposite valleys, and of a size proportionate to th
stream that made them and to its supply with detritus. The di
tinctness of these forms is proportionate to the time durin
which the sea abided at their level; and from this we conclud
at once that there has been no other post-glacial shore-line
anything like as long a life as the present one, along which cli
and bars are so well made. Moreover, all these forms are
equivalent size on any given shore-line: if one cliff is forme
others will be found in corresponding positions, and correlate
bars and deltas will complete the record. Glacial imitations
shore-line topography are also discussed. With these genera
zations thought out and talked over, the field-work begins
take shape: the student does not wander aimlessly over the are
assigned to him, but searches intelligently for significant signs
water action. On finding a flat, sandy field extending seawar
from the foot of a clean rocky slope, the hint is followed b
contouring around the hill-sides; if the walk lead to a mor
sheltered position, look for little deltas where brooks come dow
ravines; if to a more exposed promontory, look for cut cli
and built bars, and so on over the country. The results in th
particular search were not what is commonly called "satis
factory"; that is, continuous and consistent shore-marks were
not surely found up to a hundred feet elevation, although
strongly suspected at sixty feet in some places; but this do
means that the question is of a larger instead of a smaller orde
not that it is unprofitable to the student. If the generally ac
cepted post-glacial depression and higher stand of the sea
Boston is thus discredited by local observation, it must not b
accepted on the ground of reported depression at not dissim
localities, for they may be similarly discredited, as has lately
happened on Long Island. The occurrence of high-level shel
at Winthrop does not alone suffice to prove so large a matter a

a change of continental level; it only opens a question that must be closed by independent evidence, and at present the evidence of *post*-glacial depression in Southern New England is very incomplete. The investigation is therefore highly satisfactory in leaving us with the watchfulness of uncertainty instead of blindfolding our eyes with a definite conclusion.

I have said but a word about summer schools. They deserve more mention, for they are invaluable; they cannot be replaced by any term-time instruction. The student is led by them to new fields and new problems, so widely different from those of his college course, that only the all-embracing subject of geology could bring them under one name. Continuity of work is also a great merit of these schools. They do not suffer from the distraction of other occupations that ordinary teaching has to contend with, and six steady weeks in summer may be made a full equivalent of an all-winter's interrupted course.

It need hardly be said that this course of instruction is not planned with a view of teaching the student much of what has been learned in geology. That is attended to in other courses by means of lectures, reading, and thesis-writing. The work here described is designed chiefly to place the student where he may gain something of the spirit of investigation. Rocks and structures are shown in but moderate variety, and quotation of simple fact thus learned is not expected to be of great service afterwards; but the facts that have been learned come as directly as possible from Nature, whom the student thus finds that even he may profitably question. Individual judgment is spurred on to take the place of the appeal to authority, and the judgment thus grows by exercise even to its own surprise. Thus, with observation and argument combined, the student finds himself possessed of general methods of work that prepare him to attack problems unlike any that he has met in his schooling. Further study under new teachers in new fields may then be followed to great advantage, but perhaps the best teacher at this stage is practical experience.

HISTORY OF GARDEN VEGETABLES.

BY E. LEWIS STURTEVANT, A.M., M.D.[1]

(Continued from page 712.)

Chinese Cabbage. *Brassica chinensis.*

But little appears to be recorded concerning the varieties of this cabbage, of which the *Pak choi* and the *Pe-tsai* only have reached European culture. It has, however, been long under cultivation in China, as it can be identified in Chinese works on agriculture of the fifth, sixteenth, seventeenth, and eighteenth centuries.[2] Loureiro[3] (1790) says also cultivated in Cochin China; and varieties are named with white and yellow flowers. The *Pak choi* has more resemblance to a chard than to a cabbage, having oblong or oval, dark, shining-green leaves upon long, very white, and swollen stalks. The *Pe-tsai*, however, rather resembles a Cos lettuce, forming an elongated head rather full and compact, and the leaves a little wrinkled and undulate on the borders.[4] Both varieties have, however, a common aspect, and are annuals.

Considering that the round-headed cabbage is the only sort figured by the herbalists, and that the pointed-headed early cabbages appeared only at a comparatively recent date, and certain resemblances between the *Pe-tsai* and the long-headed cabbages, it is not an impossible suggestion that these cabbage-forms appeared as the effect of cross-fertilization with the Chinese cabbage; but until the Cabbage family has received more study in its varieties, and the results of hybridization are better understood, no certain conclusion can be reached. It is, however, certain that occasional rare sports or variables from the seed of our early long-headed cabbages show the heavy veining and the limb of the leaf extending down the stalk, and suggest strongly the Chinese type. At present, however, our views as to the origin of our various types of cabbage must be considered as largely speculative.

[1] Director of the New York Agricultural Experiment Station, Geneva.

[2] Bretschneider, Bot. Sin., 59, 78, 83, 85.

[3] Loureiro, Fl. Cochinch., 397.

[4] Vilmorin, The Veg. Gard., 1885, 147.

Chives. *Allium schœnoprasum* L.

These are small and unimportant members of the Onion family, found native throughout Europe, in Siberia even to Kamschatka,[1] and in North America, upon the shores of Lakes Huron, Superior, and northward;[2] but the form found in the Alps comes the nearest to that under cultivation. Although probably known to the ancients, yet we seem unable to fully identify them with the varieties of the onion named by Theophrastus, Columella, and others. They were planted in gardens in Europe in the sixteenth century, and were in American gardens preceding 1806. In England, described by Gerarde[3] (1597), called "a pleasant Sawce and good Pot-herb" by Worlidge[4] in 1683, are among seedsmen's supplies[5] in 1726, and are recorded as formerly in great request, but now of little regard, by Bryant[6] in 1783.

Chives, sives,[4] civet or sweth,[3] are called, in France, *ciboulette, civette, appetit, cive, fausse echalote;* in Germany, *schnittlauch, grasslauch;* Flanders and Holland, *bieslook;* in Italy, *cipollina;* in Spain, *cebollino;*[7] in Portugal, *cebolinha;* in Denmark, *graslog;* in Poland, *luczer-lupny.*[8]

The only indication of variety I find is in Noisette,[9] who enumerates the *civette*, the *cive d'Angleterre*, and the *cive de Portugal*, but says these are the same, only modified by soil. The use of the leaves as a condiment is well known. The plant is an humble one, and is propagated by the bulbs, for, although it produces flowers, these are invariably sterile, according to Vilmorin.

Chufa. *Cyperus esculentus* L.

The chufa was distributed from the United States Patent Office in 1854, and has received a spasmodic culture in gardens. It is much cultivated in Southern Europe, Asia, and Africa, becoming of importance at Valence, in Galicia, and in the environs of Rosetta and Damietta, in Egypt.[10] In Hungary it is grown for the seeds, used as a coffee substitute,[11] but in general for its tubers, which are sweet, nutty, and palatable. These bulbs, says Bryant,[12]

[1] De Candolle, Orig. des Pl. Cult., 57.
[2] Gray, Man. of Bot.
[3] Gerarde, Herbal, 1597, 139.
[4] Worlidge, Syst. Hort., 1683, 194.
[5] Townsend, Seedsman, 1726, 25.
[6] Bryant, Fl. Diet., 1783, 92.
[7] Vilmorin, Les Pl. Pot., 1883, 156.
[8] McIntosh, Book of the Gard., ii. 47.
[9] Noisette, Man., 1829, 353.
[10] Heuze, Les Pl. Alim., ii. 551.
[11] Loudon, Enc. of Ag., 98.
[12] Bryant, Fl. Diet., 1783, 29.

are greatly esteemed in Italy and some parts of Germany, and are frequently brought to table by way of dessert. At Constantinople the tubers appear in the markets, and are eaten raw or made into a conserve.[1] Gerarde, in 1633, speaks of their extensive use in Italy, being hawked about the streets, and, at Venice, eaten as dainties.[2] They now appear in the English markets under the name of Zulu nuts.[3] It must also have been esteemed in ancient times, for tubers have been found in Egyptian tombs of the twelfth dynasty, or from two thousand two hundred to two thousand four hundred years before Christ.[4]

Laurembergius, in his "Apparatus Plantarum," 1632, calls them *Gramen amygdalosum*, commonly called *Thrasi veronensium;* conveniently called *Dulcichinum*, *Dulcinium*, *Cyperus esculentus*, *Cyperus angustifolius*, *Juncus avellana*, *Margarita agri*, etc. They are figured or described by nearly all the early botanists.

The *chufa*, *earth-almond*, or *rush-nut* is called, in France, *souchet comestible*, *amande de terre*, *souchet sultan*, *souchet tubéreux*, *trasi;* in Germany, *erdmandel;* in Flanders, *aardmandel;* in Italy, *mandorla di terra*, *dolcicchini;* in Spain, *chufa*, *cotufa;* in the Soudan, *nebbon;* in Egypt, *ab-el-azis;*[6] in Arabic, *habb-el-aziz*—i.e., *granum dilectum.*[7]

Notwithstanding the long-continued culture of this plant, I find no varieties described.

Clary. *Salvia sclarea* L.

The common Clary was formerly much more cultivated in gardens than at present. Townsend,[8] in 1726, says "the Leaves of it are used in Omlets, made with Eggs, and so must be in a garden." In 1778, Mawe[9] gives three varieties,—the broad-leaved, the long-leaved, and the most wrinkled-leaved. It is mentioned as cultivated in England by Ray,[10] 1686; Gerarde,[11] 1597; and it is the orminum of Turner,[12] 1538. It was in American gardens preceding 1806,[13] and now occurs wild in Pennsylvania, naturalized as an escape,[14] its home being the East Mediterranean.

[1] Walsh., Hort. Trans., vi. 50.
[2] Gerarde, Herbal, 1633, 32.
[3] Gard. Chron., June 24, 1882, 838.
[4] Schweinfurth, Nature, Jan. 31, 1883, 318.
[5] Vilmorin, Les Pl. Pot., 1883, 551.
[6] Heuze, Les Pl. Alim., ii. 551.
[7] Delile, Fl. Ægypt, illust.
[8] Townsend, Seedsman, 1726, 34.
[9] Mawe, Gard., 1778.
[10] Ray, Hist., 1686, 543.
[11] Gerarde, Herb., 1597, 626.
[12] Turner, Libellus (fac-simile reprint), 1538.
[13] McMahon, Am. Gard. Kal., 1806.
[14] Gray, Syn. Fl., ii. pt. 1, 372.

iterranean countries. The leaves are used for seasoning, but their use with us has been largely superseded by sage, and, although the seed is yet sold by some of the seedsmen, I imagine that it is but little grown.

The Clary is called, in France, *sauge sclarée*, *sclarée*, *toute-bonne*, *orvale*; in Germany, *muscateller salbei.*

Claytonia. *Claytonia perfoliata* Don.

The leaves of this plant are eaten as salad, or cooked like ordinary spinage. It is a native of Cuba, as also of North America, where the variety *exigua* Torrey is in popular use in California as a potherb.[1] It was first described in 1794, but in 1829 was not named by Noisette[2] for French gardens, and in 1855 is said by De Candolle[3] to be occasionally cultivated as a vegetable in England. It is now included by Vilmorin among French vegetables.

In England it is called *winter purslane*; in France, *claytone perfoliée*, *claytone de Cuba*, *pourpier d'hiver*; in Flanders, *doorwas*; in Holland, *winter-postelijn*; in Spain, *verdolaga de Cuba.*

Its synonymy is:

Claytonia perfoliata Don. Pursh, Fl. of N. Am., i. 170.
C. perfoliata Don., *var. exigua* Torr. Brewer & Watson, Bot. of Cal.
C. Cubensis, Humb. et Bonpl. Kunth, Syn., iii. 379.

Corchorus. *Corchorus olitorius* L.

This plant is valued as a spinage plant in warm countries. It is mentioned by Pliny[4] among Egyptian potherbs, and Alpinus,[5] in 1592, says that no herb is more commonly used among the Egyptian foods. Forskal[6] also mentions its cultivation in Egypt, and notes it among the cultivated esculents of Arabia. In India it occurs wild, and the leaves are gathered and eaten as spinage.[7] In tropical Africa it is both spontaneous and cultivated as a vegetable,[8] and it is cultivated in the vegetable-gardens of the Mauritius.[9] In Jamaica the plant is frequently met with in gardens, but has, in a great measure, ceased to be cultivated,

[1] Brewer & Watson, Bot. of Cal.
[2] Noisette, Man., 1829.
[3] De Candolle, Geog. Bot., 662.
[4] Pliny, lib. xxi. c. 52, c. 106.
[5] Alpinus, De Plant. Ægypt, 1592, 39.
[6] Forskal, Fl. Ægypt.-Arab., xciii. 101.
[7] Speede, Ind. Handb. of Gard.
[8] Oliver, Fl. of Trop. Afr., i. 262.
[9] Bojer, Fl. Maurit., 42.

although the leaves are used as a spinage.[1] It is now cultivated in French gardens for its young leaves, which are eaten in salads. It is recorded by Burr[3] as in American gardens in 1863, but I have never seen the plant growing. This plant furnishes a portion of the Jute fibre of commerce.

The *Jew's mallow*, or *Corchorus*, is called, in France, *corète potagere*, *guimauve potagere*, *mauve des juifs*, *brede malabare*; in Germany, *gemuse-Corchorus*, *nusskraut*;[2] in Arabia, *melochia*;[4] in Arabic, *meloukhyeh*;[5] in Bengali, *pat*, *koshta*, *bhungee*,[6] *bhungee pat*;[7] in Hindustani, *singin janaseha*;[7] in Sanscrit, *putta*;[8] in Telegu, *parinta*.[8]

I find no varieties recorded.

Coriander. *Coriandrum sativum* L.

The ripe fruits of the coriander have served as a spice and a seasoning from very remote times, its seeds having been found in Egyptian tombs of the twenty-first dynasty,[9] and a thousand or so years later Pliny[10] says the best came to Italy from Egypt. Cato,[11] in the third century before Christ, recommends coriander as a seasoning; and Columella,[12] in the first century of our era, and Palladius,[13] in the third, direct its planting. The plant was well known in Britain prior to the Norman conquest,[14] and was carried to Massachusetts before 1670.[15] In China it can be identified in an agricultural treatise of the fifth century, and is classed as cultivated by later writers of the sixteenth and eighteenth centuries.[16] In Cochin China it is recorded as less grown than in China.[17] In India it is largely used by the natives as a condiment,[18] is grown at the Mauritius,[19] and has even reached Paraguay, and is in especial esteem for condimental purposes in some parts of Peru.[20]

Coriander, called coryander and colander by Turner[21] in 1538,

[1] Macfadyen, Jam., i. 108.
[2] Vilmorin, Les Pl. Pot., 168.
[3] Burr, Field and Gard. Veg., 338.
[4] Forskal, Fl. Ægypt.-Arab., xciii. 100.
[5] Delile, Fl. Ægypt, illust.
[6] Birdwood, Veg. Prod. of Bomb., 39
[7] Drury, Useful Pl. of Ind., 159.
[8] C. Benson, Saidapet Farm, Madras.
[9] Nature, May 31, 1883, 113.
[10] Pliny, lib. xx. c. 82.
[11] Cato, c. 15
[12] Columella, lib. vi. c. 33; lib. x. c. 244; lib. xi. c. 3.
[13] Palladius, lib. iii. c. 24; lib. iv. c. 9, etc.
[14] Pharmacographia, 1879, 329.
[15] Josselyn, Rar.
[16] Bretschneider, Bot. Sin., 78, 59, 85.
[17] Loureiro, Cochinch., 180.
[18] Dutt, Hindu Mat. Med., 175.
[19] Bojer, Hort. Maur.
[20] Johnson, Useful Pl., 125.
[21] Turner, Libellus, 1538.

is called, in France, *coriandre;* in Germany, *coriander;* in Flanders and Holland, *koriander;* in Denmark, *koriander;* in Italy, *coriandorlo;* in Spain, *culantro, cilantro.*[1] The name is probably derived from the Greek *koris*, a bug, from the offensive smell of the leaves. In Arabic, *kouzbarah,*[2] *kuzeerah;*[3] in Bengali, *dhunya;*[4] in Ceylon, *cotumbaroo;* in Malay, *mety;* in Persian, *kushneez;* in Tamil and Telegu, *cottamillie;*[3] in Sanscrit, *dunya, dhanyaca.*[3]

Notwithstanding this extended period of cultivation, I find no indication of varieties under cultivation.

Corn. *Zea mays* L., var. *saccharata.*

The history of sweet corn, so far as we have discovered it, is given in the American Naturalist for July, 1885. It is first noticed in 1779. In the "Report of the New York Agricultural Experiment Station" for 1884 I have described thirty-three sorts, and in the report for 1886 a new form collected from the Indians of Mexico is mentioned and partly described. This vegetable is grown far more in the United States than in Europe, and has become an object of field-culture for the supply of the canning industries.

The European names of sweet corn I do not find noted, except the *mais sucre* of the French. By Vilmorin the generic name of the species is applied to this variety in his synonymy.

The presence of three distinct types, varying not alone in appearance, but as well in their climatic adaptations, and the large number of varieties quite distinct in minor features, indicate a previous culture far more extended than appears in my recorded notes. It certainly does not seem reasonable to believe that sweet corn was confined until 1779 to North American aboriginal culture alone, and yet I have not even a clue that suggests otherwise.

Corn Salad. *Valerianella olitoria* Moench.

This annual plant has been found spontaneous in all temperate Europe as far as 60° north; in Southern Europe to the Canary Isles, Madeira, and the Azores; in North Africa, Asia Minor,

[1] Vilmorin, Les Pl. Pot., 168.
[2] Delile, Fl. Ægypt, illust.
[3] Birdwood, Veg. Prod. of Bomb., 39, 162, 237.
[4] Drury, Useful Pl. of Ind., 162.

and in the region of the Caucasus.[1] It seems quite a variable plant in nature, but as long ago as 1623 Bauhin[2] records its variability in size, and occurring with narrow, broad, and entire leaves. It is described by Lobel[3] in 1576, and by Dalechamp[4] in 1587, as also by Camerarius[5] in 1588, but as occurring in fields, and without mention of culture, although its value as a salad is recognized. In 1597, Gerarde[6] says it has grown in use among the French and Dutch strangers in England, and "hath beene sowen in gardens as a sallad herbe." He figures two varieties. J. Bauhin[7] describes two sorts, and gives Tabernæmontanus as a witness that it was found in gardens as well as in fields and vineyards. Ray,[8] in 1686, quotes J. Bauhin only, and Chabræus,[9] in 1677, describes it as grown in gardens as a salad herb. Worlidge[10] in 1683, Meager[11] in 1683, Quintyne[12] in 1693 and 1704, Townsend[13] in 1726, Stevenson[14] in 1765, Mawe[15] in 1778, Bryant[16] in 1783,—all refer to its culture in England. In France, according to Heuze,[17] it is spoken of as cultivated by Olivier de Serres, and is referred to as if a well-known cultivated salad in "Le Jardinier Solitaire," 1612. It was in American gardens previous to 1806.[18]

Vilmorin[19] describes four varieties, which are tolerably distinct. All these have blunt leaves. The variety quite frequently distributed for American gardens is that which is figured by the herbalists as having pointed leaves, as, for instance,—

Phu minimum alterum. Lob., 1576, 412; Lugd., 1587, 1127;
Polypremnum. Lugd., 1587, 554;
Lactuca agnina. Ger., 1597, 242; etc.

The round-leaved form, such as the *mache ronde* of Vilmorin, has its type figured by Dodonæus in his "Pemptades," 1616, under the name of *album olus.*

[1] De Candolle, Orig. Des Pl. Cult., 37.
[2] Bauhin, Pin., 1623, 165, No. xix.
[3] Lobel, Obs., 1576, 413; fig., p. 412.
[4] Hist. Gen. Lugd., 1587, 554, 1127; fig.
[5] Camerarius, Hort., 1588, 175.
[6] Gerarde, Herbal, 1597, 243.
[7] J. Bauhin, Hist., 1651, iii. 324.
[8] Ray, Hist., 1686, 392.
[9] Chabræus, 1677, 437.
[10] Worlidge, Syst.-Hort., 1683, 214.
[11] Meager, Eng. Gard., 1683 (?), 61.
[12] Quintyne, Comm. Gard., 1693, 144; 1704, 205.
[13] Townsend, Seedsman, 1726, 16.
[14] Stevenson, 1765, 34.
[15] Mawe, Gard., 1778.
[16] Bryant, Fl. Diet., 1783, 116.
[17] Heuze, Les Pl. Alim., i. v.
[18] McMahon, Am. Gard. Kal., 1806.
[19] Vilmorin, The Veg. Gard., 1885, 202.

The names of the *Corn salad*, or *Fetticus*, or *Lamb's lettuce*, are, in France, *mache commune*, *accroupie*, *barbe de chanoine*, *blanchette*, *blanquette*, *boursette*, *chuquette*, *clairette*, *coquille*, *doucette*, *gallinette*, *laitue de brebis*, *orillette*, *pommette*, *poule grasse*, *rampon* (à Geneve), *salade de ble*, *salade de chanoine*, *salade royale;* in Germany, *ackersalat*, *feldsalat*, *lammersalat*, *mausohr*, *rabinschen*, *rapunzel*, *schafmaulchen;* in Flanders and Holland, *koornsalad*, *veldsalad;* in Holland, *veldsla;* in Denmark, *kropsalat;* in Italy, *valeriana*, *erba riccia*, *dolcetta*, *gallinelle*,[1] *sarzet;*[2] in Spain, *canonigos;* in Portugal, *herva benta;* in the Mauritius, *mache*, *doucette*.[3]

Among the more ancient names are: Belgian, *velt cropper*, Lob., 1576; *witmoes*, *veltecrop*, *elcerooge*, Dod., 1616; gallo-belgian, *sallade de chanoine*, Lob., 1756; in English, *lamb's lettuce*, *corne sallade*, Gerarde, 1597; in France, *blanchette*, *poule grasse*, Lugd., 1587; *mache*, "Le Jard. Solit.," 1612.

(To be continued.)

EDITORS' TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

THE meeting of the American Association for the Advancement of Science, which has just closed its sessions in New York, was in some respects a noteworthy one. Nature was kinder to her worshippers than has been often the case at this season of the year in regions of small elevation and corresponding latitude, and the temperature experienced in New York was a delightful interlude in a season of exceptional heat and humidity. Although many of the citizens were living at their summer resorts, the entertainment furnished was fully equal to the anticipations and needs of the Association. Indeed, greater hospitality could not have been enjoyed without impairing the effectiveness of the meetings, and it is fortunate from this stand-point that New York's capacity in this respect was not more seriously taxed. As to the meeting, it may be truly said that the quality of the papers offered never was higher, and their interest and importance was never greater. The attendance, though not equal to

[1] Vilmorin, Les Pl. Pot., 1883, 322.
[2] Allioni, Fl. Pied., 1785, n. 12.
[3] Bojer, Hort. Maurit., 1837, 174.

that at the Boston and Philadelphia meetings, was very good, numbering about seven hundred and fifty members. The United States Geological Survey was better represented than at any previous meeting. The excursions about the city covered a wider range of interest than at any previous meeting; physicists, social economists, biologists, and geologists being equally well provided for. In all respects the local committee, aided by the New York Academy of Sciences, succeeded in making the meeting enjoyable to all participants.

Most of the members will agree with us, however, that some comments on the treatment of the Association by the press of New York are in order. It may be asserted that at no late meeting has the work of the Association met with less appreciation from the newspapers of the locality where it has met than in New York. Some of the reports published were of the flippant jocular type, the wit in some instances apparently emanating from very callow reportorial brains. In no instance were full reports given, but the fullest were always those of the least scientific communications, such as that of a Chinese gentleman, which never should have been read at all. We had thought that the reports of the *Tribune* would have redeemed the reputation of the press so far as possible, but even these depreciated after a very good beginning, and terminated in an extraordinary flare in a farewell editorial on August the 18th. Had we a funny column, we would reprint the first half of this editorial entire, but we must be content with making some comments on it, for it represents very correctly the attitude of the New York press towards American science for many years past.

The editorial opens with the following cheerful assertion: "The most noteworthy scientific congress that has met on this side of the Atlantic was the Montreal session of the British Association in 1884." We commend this sentence as a model of veracity (?) and good taste (?). "At the close of the session one of the learned presidents of the sections declared that its most important contribution to the world's stock of knowledge was the announcement, in a cable despatch from Australia, that monotremes were shown by actual observation to be oviparous." "Indeed, the meetings of the British and American Associations are seldom memorable for discoveries or even discussions of phenomenal importance. A few notable addresses have been

made in England by such leaders of the scientific world as Professor Huxley and Professor Tyndall, . . . " Now, we are not prepared to speak for the British Association, but it has been quite the custom for American scientists to announce their most important discoveries in papers read before the American Association. Such was the case at the Philadelphia meeting, which followed immediately the notable meeting at Montreal. Among other important communications made, it was announced that the ancestors of the monotremes had been discovered in the reptiles of the Permian formation of Texas, a fact which was new, and important from every point of view. The fact that the monotremes are oviparous had been known for perhaps forty years. Another fact discovered by the English biologist, that the segmentation of the yelk of the monotremes is meroblastic, was really new, and formed a remarkable confirmation of the discovery announced in Philadelphia. Such coincident discoveries are rare in the history of science, and the present instance was, under the circumstances, especially interesting. As usual, the *Tribune* cannot cite any "notable addresses" delivered before the Association by Americans. Under the circumstances, our past presidents and vice-presidents will pardon us the assertion that such have been really delivered in this country also! To what extent the general indifference to science which prevails in New York is due to this kind of writing it might be interesting to inquire. The succeeding paragraph of this editorial shows some appreciation of the New York session, for which we extend thanks. We must, nevertheless, proffer to the *Tribune* one piece of advice,—viz., that it employ on its scientific work in future an American, and one who knows something of American science and scientists. In this way it may become what it once aimed to be in New York City, a scientific missionary *in partibus infidelium.*

The American Committee of the International Congress of Geologists has survived the perils which threatened it at the New York meeting of the American Association. After an existence of several years, and the accomplishment of a great deal of work, it began to attract the attention of the present director of the United States Geological Survey. Although a member of the committee, the director has not taken part in its work

until just before the meeting of the Association, excepting by deputy, who was permitted by courtesy to be present at its deliberations. At the present stage of progress the director became very desirous of controlling the committee, and exhausted all the arts of parliamentary usage to accomplish that result. His efforts were, however, not successful, and the committee received a new lease of life by a resolution of approval adopted by Section E (the Geological), and of continuation by the Association at large. The committee thus represents officially in the Congress American geological opinion, and it will no doubt endeavor to do so with the utmost impartiality. As a representative body it is well constituted. It embraces the following representation:

	Members.
United States Geological Survey	4
United States Geological Survey of the Territories (Hayden's)	1
United States Geological Survey W. of 100th mer. (Wheeler's)	1
State Survey, Alabama	1
State Survey, Minnesota	1
State Survey, New York	1
State Survey, New Hampshire	1
State Survey, Pennsylvania	2
State Survey, New Jersey	1
	13

In our opinion no scientific or other reasonable ground for a change in the representative character of the committee exists and we are glad that no change has been made.

WITH the death of Professor Spencer F. Baird a landmark in American science has disappeared. We find it difficult to express adequately our sense of the important bearing which the life of Professor Baird has had on the present state of science in America. More than any other man he built up and sustained the existing body of zoologists in this country by his generous recognition and still more generous material support. To him, more than to any one man, science owes the recognition it has had in the councils of the nation, and the substantial support which it has received at the hands of our government. No one ever justly questioned his motives, for it was known to everybody that they were not selfish, and that the advancement of science was the one object of his life. His success is attested by the National Museum, and the Fish Commission, of the United States; two achievements

which have few parallels in the history of science. In the presence of Professor Baird's immense services to science in America, we can nevertheless pause to pay a tribute to the worth of his character. Perhaps his leading trait was a comprehensive benevolence which knew no distinctions, but embraced all in its benefactions to the limit of possibility.

Professor Baird's disinterested love of science will not be lost to us by his death. To his foresight is due the fact that he will probably be succeeded by men equally catholic with himself, and equally able to maintain the dignity of science at the national capital. We refer to Professor S. P. Langley, the present assistant secretary, and Mr. G. Brown Goode, assistant director of the National Museum.

GENERAL NOTES.

GEOLOGY AND PALÆONTOLOGY.

On the Morphology and Origin of the Ichthyopterygia.[1]—There is no group of reptiles, the Testudinata perhaps excluded, of which the morphology of the skeleton and the origin has been more discussed than that of the Ichthyopterygia.

As the name says, the Ichthyosaurs were long considered as animals which had retained characters of fishes. The limb-bones developed as paddles were regarded as original stages, forming a link between the fishes and the higher Vertebrata. I shall show in the following note that the Ichthyosaurs are specialized Sphenodon-like reptiles, and that their fins are not original but secondary formations, like the paddles of the Cetaceans.

The Skull.—The skull is only comparable with that of the Rhynchocephalia, especially Sphenodon and the Lacertilia. The only real difference is that, like in the Cetaceans, the anterior part of the skull has been very much elongated. The *general* structure of the skull resembles that of the dolphins. In its *morphology* it is a copy of the Sphenodon skull.

The foramen magnum is bounded by four bones,—the large basioccipital, the two exoccipitals, and the supraoccipital. These parts are well known. Of the otic bones two are separated; the third, the epiotic, if ever free, is coossified as in all reptiles with the supraoccipitals. The opisthotic is a pretty large conical bone, touching the exoccipital and supraoccipital.

[1] A paper read before the American Association for the Advancement of Science, August 12, 1887.

The prootic is a small flat elliptical bone, connected with the base of the skull, the supraoccipital, and the opisthotic. The structure of the bones shows that there must have been developed large masses of cartilage, still more than in young sea-turtles, connecting these bones.

Between the basioccipital and the quadrate a strong handle-like bone is expanded, fitting in a grove of the quadrate. This is the stapes, as Professor Cope correctly suggested, exactly in the same position as in Sphenodon, in which it is of similar shape but not so stout.

Turning now to the upper part of the skull, we find the parietal bones of exactly the same structure as in Sphenodon, and in front of those the very small frontals.

The parietal foramen, which is very large, as in Sphenodon, is situated between the frontals and parietals or in the frontals, in a similar way as in Sphenodon. In the upper part of the Sphenodon skull the parietal foramen is formed entirely by the parietals, in the lower part by both the parietals and frontals. The nasals in Ichthyosaurus are very large bones, touching the frontals, parietals, postfrontals, prefrontals, lachrymals, and premaxillaries.

We have now to consider that part of the skull situated between the supratemporal fossa, the orbits, and the quadrate.

The supratemporal fossa is formed by three bones,—the parietal, the postfrontal, and a big bone forming its posterior and exterior border. This bone, which is connected also with the quadrate and another bone which joins the quadrate, quadratojugal, postorbital, and postfrontal, is the *supratemporal* of the Lacertilia, which is united in Sphenodon to the squamosal.

This bone is called mastoid by Owen, squamosal by Seeley and Cope, but it is in fact the supratemporal bone of the Lacertilia.

Between this bone, the postfrontal, postorbital, quadratojugal and quadrate, another bone is articulated. This bone represents the *true* squamosal of the Lacertilia, the *prosquamosal* of Owen and the *supraquadrate* of Seeley.

The place which is taken in Ichthyosaurus by the supratemporal and squamosal is taken in Sphenodon by one bone only. This represents the supratemporosquamosal.

The quadratojugal of Ichthyosaurus is connected with the squamosal, postorbital, jugal, and quadrate exactly as in Sphenodon, where it ossifies later with the quadrate.

There is a foramen in Ichthyosaurus, between the quadrate and quadratojugal just as in Sphenodon. Ichthyosaurus has an epipterygoid (columella), as A. Smith Woodward has shown, of the same form and connection as Sphenodon.

The lachrymal is free from the prefrontal in Ichthyosaurus, as in many Lacertilians; it is united with that bone in Sphenodon.

The vertebræ of Ichthyosaurus are only specialized from a Sphenodon-like form in which the notochordal character was

already lost. The ribs are two-headed, and are always connected with the centrum of the vertebræ. There are only three small intercentra developed between the basioccipital and atlas, and the two next vertebræ.

The abdominal ribs consist of a median piece just as in Sphenodon, to this one or two lateral pieces are attached on both sides. In Sphenodon there are two pairs of abdominal ribs connected with one pair of true ribs, in Ichthyosaurus only one.

The shoulder-girdle is only comparable with that of Sphenodon; the clavicles and interclavicles are very much alike; the scapula and coracoid resemble very much the same elements in young Sphenodons when they are still free.

The pelvis of Ichthyosaurus is in a rudimentary condition; it contains the three elements, but a comparison with other pelves is of no value.

The limbs are specialized for the animal's life in water from some land-living form, as I shall show.

The limbs or paddles of the Ichthyopterygia were a principal reason for giving a peculiar position to those animals in the system.

I have shown before, on logical reasons, that the paddles of Ichthyosaurus were not original but adapted. To-day I can give the proofs for this.

In the Museo Civico of Milano, in Italy, are some specimens of Ichthyosaurus from the Trias of Besano. They have been noted lately by Professor F. Basani, and called *Ichthyosaurus cornalianus*. The specimens measure from 50 to 90 cm. only.

The teeth are of smaller number than in the other Ichthyosaurians, and of two forms. But the most important character not mentioned by Basani is the structure of the limbs. Radius and ulna are not as in the other Ichthyopterygia, short bones which touch each other without space, but they are more elongate, leaving a space between them. This one character alone is sufficient to establish a new genus, which I propose to call *Mixosaurus*; constituting a distinct family, the *Mixosauridæ*.

The fins of Baptanodon or Sauranodon Marsh have been regarded as the oldest ones. It is just the reverse of it; they are the newest, most specialized forms.

The bone considered by Professor Marsh as intermedium is not this element, but the ulna; the ulna of Professor Marsh represents probably the pisiforme.

The oldest Ichthyopterygia had few phalanges and not more than five digits; radius and ulna were longer than broad, and separated by a space. Later, through the adaptation to the water, more phalanges were developed, more digits appeared, mostly by division of the former or by new formation on the ulnar side. I have never found a new digit developed on the radial side.

The fin of Baptanodon was developed by the trans-location of the pisiforme or another element of a new-formed ray to the humerus.

Just the same we observe in the Sauropterygia.

In the oldest Triassic forms, the Lariosauridæ, we have forms with extremities, where radius and ulna are long bones, and the number of phalanges as in the Lacertilians. In the Lias specimens, the Plesiosauridæ, radius and ulna become smaller, the number of phalanges enlarged.

In the specimens of the Kimmeridge, *Pliosaurus*, (? in all) we have three short bones connected with the humerus, just as in Baptanodon.

The Cetacean paddle has developed in the same way as Ryder has suggested; a new proof is given by the Sirenidæ.

Flower says, in the last edition of his "Osteology of the Mammalia," that the number of phalanges in the Sirenia is never increased in number beyond the limit usual in the Mammalia—*that is, three.* But Dr. H. Gadow, in Cambridge, England, showed me a manus of *Manatus americ.*, prepared in alcohol, which contained a fourth small ossified phalange in the third digit, and one of *Halicore dugong* which contained an ossified fourth phalange at the fourth, and a cartilaginous fourth in the third digit.

This shows how the supernumerary phalanges were developed, and it is remarkable to say that the embryo of *Halicore* examined by Lebouq contained only three phalanges. The increase takes place during the life of the individual through mechanical influence.

I do not longer doubt that the Ichthyopterygia were developed from land-living reptiles which very much approached the Sphenodontidæ.

Classification of the Ichthyopterygia.—a. Radius and ulna elongated, separated by a space in the middle. Teeth of two forms but not so numerous as in the Ichthyosauridæ. Small animals. Triassic.

Family *Mixosauridæ* Baur.

Genus *Mixosaurus* Baur.

b. Radius and ulna short bones, touching each other. Teeth well developed and numerous.

Family *Ichthyosauridæ* Bonaparte.

Genus *Ichthyosaurus* Koenig. There are, however, several genera contained in Ichthyosaurus, as Seeley has already suggested.

c. Radius, ulna, and a third bone articulating with the humerus; teeth rudimentary or absent.[1]

Family *Baptanodontidæ* Marsh.

Genus *Baptanodon* Marsh.—*Dr. G. Baur, New Haven, Conn.*

[1] I have seen small teeth at the end of the jaws of the Baptanodontidæ contained in the private collection of Mr. Leeds in Peterborough, England.

The Address of Vice-President G. K. Gilbert before Section E; A. A. A. S., Columbia College, New York, August 10, 1887.—Mr. Gilbert's address was a well-written composition, which bore the same title as the pamphlet published by the undersigned, under the auspices of the American Committee,—"The Work of the International Congress of Geologists." The easy and flowing style of the address was to have been expected by those who had read any of Mr. Gilbert's previous productions; but it must not be supposed that his fecundity of expression led him into saying too much. He has not been betrayed, for instance, into any general mention of the past work of the American Committee delegates to the Congress; nor even into any particular mention of that part of it which furnished the greater part of the material on which his address was based.

In speaking of the need for a word "to denote indefinitely an aggregate of strata," since to the word *formation*, formerly used in this manner, the Congress has attached a specific meaning, he says,—

"I suggest that we may advantageously enrich our language by the permanent adoption of *terrane*, a word whose English meaning has not been well established."

This is a singular, though doubtless inadvertent, plagiarism, since the two international committees (see "Report of Am. Com.," p. 43, etc., *a*, *c*, *d*, and pp. 50, 9, etc.) have employed the word in just this way. In the debates of the Congress also (*ibid.*, p. 22) "Professor Renevier proposed the term *terrane* (*terrain*) to avoid prejudging the rank in the classification of these rocks" (Archean). "He objected to the use of the term in any systematic sense, but believed it might be employed in a general sense." This, of course, inferred the use of the French word, with whatever pronunciation and spelling, in other tongues.

His suggestion as to the use of the termination "al" to convey ideas of time, as in Archeal, Cretaceal, Laramal, Belly Riveral, Bitter Creekal, if it will induce the local-taxonomy geologists of Mr. Gilbert's school to admit, through its employment, any generality in geological classification, will probably be easily introduced. Still, after having conceded to him an unusual command of his mother-tongue and great skill in its use, one cannot help regarding his innovations as usually more *logal* (as perhaps he himself would have phrased it of another) than logical. Nevertheless, let us hasten to observe that they are always euphonious; and, in fact, in reading his well-rounded periods, one may imagine them the agreeable cadence of word-drops caught up by some sprite of the river of language, and with the added glory of hue and tone from the intellectual light which floods them, falling back into their native bed.

In the serious matter of the address there are some passages to approve and some to disapprove. For example, in speaking

of the Congress's suggestions as to the terminations to be added to indicate groups, systems, series, etc., Mr. Gilbert says,—

"It would be impossible for a geologist to name or allude to a terrane without declaring its rank," etc.

To this it may be said that schemes of classification are not made for systematizing what we do not know, but what we do know. Nevertheless, it would not be an insuperable obstacle to speaking of the "blankary, blankic, or blankian terrane." Equally ill-founded is the fear that by too systematic a classification—

". . . Taxonomy would be conceived by many geologists as an end instead of a means, . . . and energy would be wasted in taxonomic refinement and taxonomic controversy."

Energy is wasted now, and a great deal more than if there were some fixed principle to guide the controversialists.

One line of objection, curious in one who must be assumed to have accustomed himself to take broad views of things, is this:

"A committee appointed for the purpose formulated rules for the establishment of the names of genera and species, and their report was adopted by the Congress. I have no opinion to express as to the wisdom of the rules, but it is a matter of surprise that a body of geologists assumed to speak with authority on the subject. From one point of view palæontology is a part of geology; from another point of view it is a part of biology. In so far as it names genera and species it is purely biologic, and it would seem proper that students of fossils unite with students of living animals and living plants in the adoption of rules of nomenclature."

Is it forgotten by Mr. Gilbert that the field of palæontology has been occupied almost exclusively by students of living plants and animals on account of its rich promise of results in determining those questions of derivative origin with which the address of this year's president of the Association was concerned? These geologic-biologists specially equipped to prosecute new inquiries are the very members of the Congress who have attempted the classification to which he alludes. He adds:

"The same is true of mineralogy, in regard to which no action has been taken. The most intimate relations of systematic mineralogy are with chemistry."

The last sentence would hardly secure Mr. Gilbert's critical approval were he aware that, from the earliest dawn of the science of mineralogy up to the present time, some of the most pre-eminent among mineralogists have denied this. But, even if it were so, some of those best able as chemists to grapple with petrological problems have entered the field of geology for the purpose of devoting themselves to it. Towards the close of the address he touches again upon this point, as follows:

"When a matter is proposed for regulation by the Congress, the first question which should be asked is whether it falls within the legitimate purview of the convention of geologists."

But what does not fall within such purview which bears, however indirectly, upon the riddles they are trying to unravel? Is the science of geology to be classed with those occupations

which relate solely and exclusively to one thing? (Perhaps Mr. Gilbert would call them *monotaxic*.) Or is it not rather a campaign requiring for its prosecution the infantry, artillery, cavalry, pontoon-trains, sappers and miners, engineers, and all the various departments of the largest army of science? If civil engineers with a little experience in camp become among the best military engineers, if our frontiersmen make the best scouts, why may not biologists, chemists, and crystallographers whose ambition urges them to seek a wider field than their laboratories become the very leaders which geology demands? In point of fact, they do: and if Mr. Gilbert will observe in the debates of the Congress, or of any other body which discusses these questions, who take the principal parts, and whose influence is most felt, he will find men eminent in the domains of special knowledge before they ventured to advise in that realm where it was applied to the attainment of a particular purpose.

It would seem, from certain parts of the address, that Mr. Gilbert half fears and half denies that the Congress possesses infallibility, but thinks that it should never pronounce in favor of a classification until all knowledge relating to the subject has been exhausted. He says, in regard to the acceptance by the Congress of a classification of the eruptive rocks,—

"With the rapid growth of knowledge and ideas, classifications are continually remodelled, and the best is in danger of becoming obsolete before it has been printed and circulated."

This evinces a curious view of the purpose of science. Is the same not equally true of philology, of ethnology, and of anything else which can be made the subject of investigation and transformed into organized knowledge? Does Mr. Gilbert expect that the heavens will fall if the classifications of the Congress need remodelling when time and further study have given more light? Are we to wait for omniscience before we attempt to classify? Or will not, rather, the changes which the future is certain to require, however great, be easier and less distracting when the whole enlightened world can take them at once by mutual agreement?

But perhaps Mr. Gilbert does not consider the co-ordination of knowledge in geology essential; one would judge so, at least, by his remark that

"—every system and every group is local. . . . If I have properly characterized stratigraphic systems, if they are both natural and local, it goes without saying that the classification of the strata of all countries in a dozen or so systems . . . is impossible."

Were that qualifying "if" not there one would be tempted to remark that, though the writer thinks it goes *without* saying, very few will concede that this statement goes *with* the saying, and in the absence of any proof. It is a thing which Mr. Gilbert cannot possibly know enough to deny, although he may think

that none of the supporters of the proposition know enough to assert it.

In parts of the address there is some appearance of unfairness in stating the position of the Congress. Take this, for instance:

"There can be no doubt that those who originally organized the work contemplated the *enactment* of a stratigraphic classification to be applied to the entire earth and the selection of a color scheme for use either in all geologic maps or in all general geologic maps. But at the Berlin session the committee in charge of the work on the map of Europe pressed the Congress for the determination of questions on which hung the completion of the map, *and many hasty decisions were reached while not a few disputed points were referred to the Map Committee.* The decisions indicate that much *or* all of this work was provisional or of merely local application, but the *resolutions* adopted show little qualification. It should be added that the official minutes of the meeting are still unpublished."

—[It might, with grace, also have been here added whence his knowledge of the unofficial minutes came.]—The use of "enactment" in this sense conveys an impression the reverse of the fact. The Congress assembled to consult, to compare notes, and recommend; not to enact. Of course, it was, and is, hoped and believed that some plan will be arrived at of universal application. Without this, geology would be simply a more intellectual pastime than collecting postage-stamps or measuring property lines; but the implication of the entire succeeding sentence is, that the Congress, being pressed, "enacted" certain things, and left other things to be "enacted" by a subordinate committee. That all the points decided had reference to an experiment which was to be made the subject of future criticism is rendered unclear by the "much *or* all," and by the little qualification which it is said the resolutions have.

Yet this should have been understood by Mr. Gilbert, for he says, farther on,—

"By a series of resolutions a partial scheme has been selected, one color at a time, and the completion of the plan has been left to the Committee on the Map of Europe."

This certainly implies that the Map Committee has consulted the Congress as to certain portions of the former's task, and not that the latter has "enacted" colors for the world. Further:

"It is understood, in a general way, that the Congress reserves final action, and that the published legend not only belongs specifically to the map of Europe, but is provisional; still, as the map, *if generally approved*, will unquestionably be declared by the Congress an authoritative pattern for the guidance of map-makers, the plan should be freely criticised at its present stage."

If the map is open to much criticism it cannot be generally approved, and if not, it is quite proper that it should be declared a pattern. The Congress has quite abundantly shown its aversion to dictating or enacting contrary to the judgment of qualified objectors. Mr. Gilbert

. . . "cannot too strongly nor too earnestly insist that a System which is universal is artificial."

Of course, all human systems are artificial; but if Mr. Gilbert means inapplicable, and if any considerable number of competent geologists agree with him, it must be admitted that the very idea of an international congress is an absurdity. It may be doubted, however, whether this be the case, when one considers the many eminent men who have interested themselves in the Congress. Passing over his statement that no strata in the Eastern United States are pronounced Jurassic with confidence (as one in which he differs from at least as good an authority as himself), he objects to separating "a continuous rock system" (conformable strata?) which contains fossils resembling forms of the lower Jurassic at the top, and lower down others resembling forms of the Triassic, into those two systems, and says, "A Jurassic system thus established would be necessarily artificial." But in Great Britain the beds from the bottom of the Primordial to the base of the Upper Silurian make a single conformable sequence; and many other examples in Europe and this country might be cited. Indeed, it is strongly insisted by the Director of the United States Geological Survey that "systems or divisions of the second order (above the Archean) should be based primarily on biology and secondarily on physical structure." Mr. Gilbert's definition of a System as

"a great terrane separated from terranes above and below *by great unconformities*, or great life-breaks, or both,"

differs from that of his chief, as well as from the common usage.

But Mr. Gilbert prefers his

"own definition of a system, making it natural, and consequently local;"

and he opposes

"any attempt to coerce the geology of one country in a rigid matrix formed over and shaped by the geology of another country."

As to the latter, so do all geologists; but it is a different proposition to make a matrix by combining the "geologies" of all countries and fitting as much as there happens to be of each into the general mould, leaving the others to complete the gaps.

He objects to the provisional color scheme of the Map Committee, that

"—it is adjusted to the rock systems of Europe exclusively, and makes no provision whatever for the systems of other parts of the earth. The geologists of Wisconsin, for example, cannot use it without calling the Keweenawan either Cambrian or Archean," . . . if they believe that "it belongs to neither of these two categories."

The above, to be intelligible, needs a note explaining that certain eminent geologists have lately come to the conclusion that the term Archean should be restricted to the lower part of what up to the present time the world has understood it to define, and that another term should be applied to the rocks between its upper portion, as thus defined, and the base of the Primordial.

This criticism, then, assumes the form of a serious sort of pun, or a puzzle based upon the ambiguity of a word. As the greater number of the world's geologists have not yet accepted this new use of "Archean," the criticism is not fatal. Of course if the new group be accepted, the Keweenawan will be interpolated between it and the Paleozoic.

It is not the purpose of this article to criticise the plan of the spectrum proposed by Mr. Gilbert. As he says, it has been very fully discussed in the proceedings of the Bologna Congress; but it may be said that one of his canons—viz., that the groups of "hues and tones," called by the vulgar simply colors, which are to serve as a scale—

"... must be so chosen that the degree of separateness of adjacent colors shall be everywhere the same, as judged by the *normal* human eye."

will be very difficult to carry into effect, in default of the discovery of, and agreement upon, that normal eye. To no two eyes of the ordinary kind would the "separateness" be likely to appear the same. It ought also to be mentioned that, in adding the hues of purple to one end or the other of the spectrum to increase the range of the time-scale colors, he violates his own rule, and renders it impracticable to assign by its wave-length a color to an intermediate rock-mass.

The portion of the address, however, most open to objection is the end of it. He says,—

"A classification is a generalized expression of the facts of observation and the domain of the voter. If it comprises all the essential facts its sufficiency will be eventually recognized, whether its authority is individual or collective. If it does not comprise them it will inevitably be superseded, by whatever authority it may have been instituted."

This argument savors somewhat of Oriental fatalism, but no exception need be taken to the words beyond the fact that a vote of competent men is a good way to arrive at a conclusion whether a certain formulative statement be or be not the desired generalized expression. The conviction that such a vote carries will be strong in proportion to its unanimity, but, in any case, it will have to stand the test to which Mr. Gilbert alludes. He proceeds:

"For this reason I am opposed to the classification by the Congress of the sedimentary formations, and likewise to the classification of the volcanic rocks; and also regard it as ill advised that the Congress undertook the preparation of a map of Europe, for that, if more than a work of compilation, is a work of classification."

Poor Congress! About to be bereft of the power to consider the objects for which it was created, why was it called into purposeless being? Suppose that when Lavoisier and his coadjutors assembled the famous congress to decide upon a system of nomenclature and to agree upon a theory of chemistry (then largely through his efforts emerging from chaos to order) some one had said, "Your congress should consider no questions of science

but only questions of names. Within the field of names it should only comprehend what Stahl and the phlogistonists understand by them. It should therefore not attempt the classification of the elements, nor the classification of compounds made by combining elements. It should discuss no analysis unless the data be compiled from existing authorities. It should not regulate the nomenclature of somatology, for that belongs to physics and mechanics; it should not regulate the nomenclature of reactions, for that belongs to magic,—in fact, it should not meddle with names at all, for that is the domain of philology:"—would we ever have had a science of chemistry at all, or would Lavoisier and his colleagues have persisted in their reckless course of counselling and devising?

In this connection the words of the great Berzelius are very applicable:

"In every science a systematic nomenclature is necessary, but in none more than in chemistry. The confusion which reigned prior to the happy idea of Guyton de Morveau is a proof. The nomenclature which chemists have employed since 1780 is the fruit of his labors, sustained and directed by Lavoisier, Berthollet, and Fourcroy. The advantage that it presents is that whoever learns to recognize a compound can give it its true name without knowing it beforehand, so that it is unnecessary to charge the memory with a large number of different terms. . . . Furthermore, scientific nomenclature is in itself the expression of a complete theory, so that if, on the one hand, the theory furnish the name, on the other the name indicates the theory. It has been objected to this relation of a nomenclature to theory that it obliges the names to be changed with the theories, which would not be necessary in the employment of purely technical terms, that are always preserved without alteration. But as these changes are ordinarily the results of progress in the direction of clearer notions, the change of nomenclature, far from injuring, is, on the contrary, another means for facilitating the march of ideas. *In general, nothing which contributes towards rendering any part of a science stationary is advantageous:* everything must advance equally in proportion to the multiplication of discoveries and knowledge." (Berzelius, "Treatise on Chemistry," vol. i., Introduction, 1829.)

It is tolerably sure that if Mr. Gilbert expects the International Congress of Geologists to eschew all questions of science in its debates, and devote itself to the employment of playing at logograms exclusively with old data, he will be disappointed.—*Persifor Frazer.*

On the Homologies of Edestus.[1]—The genus Edestus was formed by Professor Leidy to comprise certain singular fossils from the coal-measures of the West, about which various theories have been held. The one generally received is that they are dorsal spines used as weapons of defence or offence. About a year and a half ago Dr. H. Woodward, of London, suggested that they might be pectoral fins similar to those of Pelecopterus, a genus described by Professor Cope from the Cretaceous of Kansas. The absence of any trace of articulation, the apparent evidence that there were ligaments extending to the base of

[1] Abstract of a paper read before the American Association for the Advancement of Science, August 15, 1887.

the denticles, the segmented character of the fossils, and the fact that the segments are found singly, and of different sizes which would indicate that they are shed like teeth, together with the presence of a slender curved basal bone (similar to that of Onychodus of the Devonian of Ohio) in the Australian form described by Dr. Woodward, led the author to think that these fossils are neither dorsal spines nor pectoral fins, but intermandibular teeth, which had a membranous or cartilaginous support in the American forms, and an osseous support in the Australian. These supports would bear the same relation to the mandibular arch that the glosso-hyal does to the hyoid arch.—*Fanny R. M. Hitchcock.*

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—In the continuation[2] of his work on the rocks collected by the "Challenger" expedition, Renard has reached the discussion of the geology of the islands in the Indian Ocean. Those situated in the meridional part of the ocean are divided into five groups, three of which have been examined in detail. They are all of volcanic origin, and are in no way connected with Madagascar or the land within the Antarctic circle. The island *Marion*[3] is formed of volcanic rocks of two distinct ages, readily distinguishable by differences in the character of the vegetation they support. They both consist of feldspathic basalts, with anorthite as the plagioclastic constituent. The rocks of the island *Heard* are very similar to those of *Marion*. In the neighborhood of Corinthian Bay the prevailing rock is a feldspathic basalt, in which Baveno twins of bytownite are crowded together in groups. Many of these are optically anomalous in their action between crossed nicols, a fact supposed by Renard to be due to their fine lamellation. The olivine shows cleavages parallel to oP and a pinacoid. In some cases it has suffered alteration into pilite. In addition to the basalts a few specimens of limburgite were also collected.——The same author has recently studied the rocks of Kerquellen Land,[4] which had already been examined to some extent by J. Roth.[5] Renard finds that these rocks consist principally of basalts, with amygdules of analcite and zeolites. The grains of olivine in them are grouped together like the chondra of meteoric stones. In addition to the basalts there occur on the island trachites, limburgites and phonolites. Of these the trachytes and phonolites are older than the basalts.——Two late articles on the petrography of the Tyrol add several interesting facts to our knowledge of this re-

[1] Edited by Dr. W. S. Bayley, Madison, Wisconsin.
[2] American Naturalist, Notes, 1886, p. 640.
[3] Bull. d. l. Soc. Roy. de Belg., 1886, iii. p. 245.
[4] Bul. du Mus. Roy. d'Hist. Nat. de Belg., iv. p. 223.
[5] Monatsb. d. Kön. Akad. Berlin, 1875, p. 723.

gion. Baron von Foullon[1] separates the porphyrites of the Tyrol into quartz-porphyrites, quartz-mica-porphyrites, and diabase-porphyrites. In connection with the first group, Von Foullon records the replacement of hornblende by augite near the contact of the quartz-porphyrite and granite. The second group is characterized by the presence of garnet and an epidote, with the unusual pleochroism wine-yellow and violet. Intergrowths of this mineral and hornblende take place in such a manner that the axes $\bar{b}$ and c' of the former are parallel with c' and $\bar{b}$ of the latter. The hornblende in the rock often shows a parting parallel to oP. ——In the *Neues Jahrbuch* Cathrein[2] describes six rocks from various localities in the Alps. A staurolite-mica-schist occurs at Oberinnthal. It contains numerous hemimorphic crystals of tourmaline. A garnet amphibolite is remarkable for the occurrence in it of plagioclase pseudomorphs of garnet. The interior of the garnets are changed into plagioclase, around which is an exterior zone of compact hornblende. The serpentine of this region is an altered pyroxene rock. The remains of bronzite, enstatite, and diallage can still be detected in it. The most instructive portion of the paper is that devoted to the porphyrites and pitchstone-porphyries. Of the former several varieties are recognized. The first contains epidotized plagioclase and crystals of compact hornblende. In the second, in which uralite and a little augite occur instead of hornblende, the plagioclase is sausuritized. A third variety contains brown garnets in oscillatory combinations of the dodecahedron and the icositetrahedron. They are the oldest constituent. Of the pitchstone-porphyry the author says, this rock occurs in large independent masses, breaking through the prevailing quartz-porphyry in large dikes and bosses, no transition between the two being anywhere discernible.——A schistose rock from the Grossarlthal in the Alps contains chloritoid instead of mica as its bisilicate constituent. Cathrein[3] calls it a chloritoid schist. It contains nearly five per cent. of rutile and sphene.——The rocks of the Hereroland in Southwest Africa belong principally to the class of the older eruptives.[4] The quartz grains of some of the granites contain fluid inclusions with hexahedral crystals, and are pierced through by little needles of sillimanite. The most interesting observations are those on the crystalline schists. The gneiss is remarkable for the unusual association and decomposition of its constituents. The biotite is intergrown with sillimanite, and contains zircon crystals surrounded by pleochroic "*höfe*." Orthoclase and microcline are intergrown in the manner described by Becke.[5] The former has

[1] Jahrb. d. k. k. geol. Reichsaust, 1886, p. 747.
[2] Neues Jahrb. f. Min., etc., 1887, i. p. 147.
[3] Min. u. Petrog. Mitth., viii., 1887, p. 331.
[4] H. Wulf, Min. u. Petrog. Mitth., viii., 1887, p. 193.
[5] *Cf.* Min. u. Petrog. Mitth., iv., Taf. ii. Fig. 8.

undergone alteration into pseudophite, yielding a product having very much the appearance of serpentinized olivine. The augite gneisses are divided into scapolite-bearing varieties and those that contain wallastonite. The cleavage in the scapolite, as observed by Wulf, is parallel to ∞P, and is not parallel to ∞P∞ as given in the text-books. The latter is probably a parting. The composition of the augite in both varieties approaches that of diopside. Other rocks described by Wulf are diorites, basalts, amphibolites, diorite-schists, mica-schists, etc.——Lacroix describes a gabbro from St. Clement in the Puy-de-Dôme, which contains, in addition to the usual constituents, the minerals vesuvianite, sphene, and wallastonite. The feldspar is anorthite with only 0.53 per cent. of Na_2O. It presents the appearance of having been crushed and recemented, the cementing material possessing the same optical orientation as the pieces it surrounds.

Mineralogical News.—Within the past few months the properties of quite a number of rare minerals have been investigated by mineralogists in this country and in Europe, with the results indicated below. W. C. Brögger[1] describes in detail the characteristics of *låvenite* and *cappelinite*. The former occurs on the island Låven in Langesundsfjord, and is also found in the eleolite syenite[2] of the Province of Rio Janeiro, Brazil. It forms brown to yellow, slightly transparent crystals, with a prismatic habit and vitreous lustre. It is monoclinic in crystallization with $\dot{a} : \bar{b} : c' = 1.0811 : 1 : 0.8133$, $\beta = 71° 24\frac{1}{2}'$. The twinning and the cleavage planes are parallel to the orthopinacoid, while the plane of the optical axes is the clinopinacoid. The mineral is strongly pleochroic, $\mathfrak{c} > \mathfrak{b} > \mathfrak{a}$ = red-brown, yellowish-green, and wine-yellow. Its specific gravity is 3.51, and its composition:

SiO_2	ZrO_2	Fe_2O_3 (?)	MnO	CaO	Na_2O	Loss at red heat
33.71	31.65	5.64	5.06	11.00	11.32	1.03

Cappelinite is found in a small vein in the augite syenite of Little Arö in Langesundsfjord. It occurs in thick brown hexagonal prismatic crystals with a fatty lustre. Their axial ratio is 1 : 0.4301. Their analysis yielded:

SiO_2	B_2O_3	Y_2O_3	$La(Di)_2O_3$	Ce_2O_3	ThO_2	BaO	CaO	Na_2O	K_2O	H
14.16	17.13	52.55	2.97	1.23	0.79	8.15	0.61	0.39	0.21	1

Warwickite, the borotitanate of magnesium and iron, occurring at Edenville, N. Y., is generally found in prismatic crystals elongated in the direction of the vertical axis, with a cleavage parallel to the clinopinacoid. Lacroix[3] has succeeded in obtaining measurements of these, which indicate a symmetry corresponding to that of the rhombic system. In accordance with

[1] Zeitsch. f. Kryst., x., 1885, p. 503, and Geol. För. i. Stockh. Förh., Bd. vii. 598.

[2] Fr. Graeff, N. J. B., 1887, i. p. 201. [3] Bul. d. l. Soc. Fr. du Min., ix. p. 74.

this view the plane of their optical axes is the orthopinacoid. Their bisectrix is positive and perpendicular to $\infty P\bar{\infty}$. $2E = 125°$. The mineral is pleochroic in red and brown tints. *Withamite* from the porphyrites of Glencoe, County Argyle, Scotland, the same author regards[1] simply as epidote. He also thinks[2] that *wismondine*, *sasonite*, *ottrelite*, *venasquite*, and *phyllite* are merely varieties of chloritoid, the optical properties of which he describes at length. *Xantholite* he supposed[3] to be identical with staurolite.——J. Strüver[4] does not consider *gastaldite* as a variety of glaucophane, but regards both minerals as distinct members of the amphibole group.——According to Lacroix[5] the *kirwanite* of Thomson) is a mixture of amphibole, secondary quartz, and epidote. The same author[6] finds that *hullite* from Belfast is not homogeneous, and therefore should not be regarded as a definite mineral species. He states also that Dufrenoy's *dréelite* is an impure barite.——New analyses of *agalmatolite*[7] indicate that most of the substance to which this name has been given really possesses no definite composition, but is probably a mixture of silica and hydrated silicates of potassium and aluminium, resulting from the decomposition of orthoclase.——An apparently regular mineral has been found by Vom Rath[8] in the druses of an andesite near the apex of Cerro S. Cristobal near Pachuca, Mexico. It occurs in small octahedra, sometimes twinned according to the spinel law. It is often intergrown with tridymite. Hardness = 6–7. Specific gravity = 2.27. Its composition is $SiO_2 = 91$ per cent. $Fe_2O_3.Al_2O_3 = 6.2$ per cent. Both Vom Rath and Bauer regard it as most probably regularly crystallizing silica. It has been called *christobalite* to distinguish it from quartz, tridymite, vestan (Jensch, *Pog. Ann.*, 1858, p. 320), and asmanite.——A new variety of dufrenite has been observed by Messrs. Kinch, Butler,[9] and Miers in Cornwall, England. When fresh it is found in small black or apple-green orthorhombic plates, which in the thin section appear yellow or brown. Its hardness is 4.5 and specific gravity 3.233. An analysis yielded:

H_2O	CuO	P_2O_5	Fe_2O_3	CaO
10.68	0.96	30.42	55.93	1.51

The composition of the mineral corresponds with that of Streng's *kraurite*.[10]——The composition of a micaceous mineral from a limestone in the Kaiserstuhl is recorded by Knop[11] as follows:

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	Mn_2O_3	MgO	K_2O	H_2O
35.91	1.15	15.18	10.85	0.89	22.80	2.90	10.77

[1] Bul. d. l. Soc. Fr. du Min., ix. p. 75.
[2] Ib., p. 76.
[3] Ib., p. 78.
[4] Neues Jahrb. f. Min., etc., 1887, i. p. 217.
[5] Bul. d. l. Soc. Min. d. Fr., viii., 1885, p. 428.
[6] Ib., p. 435.
[7] Min. Mag., July, 1886, pp. 24 and 29; Dec. 1886, p. 74.
[8] Neues Jahrb. f. Min., etc., 1887, i. p. 198.
[9] Min. Mag., Dec. 1886, p. 65.
[10] Neues Jahrb. f. Min., 1881, i. p. 101.
[11] Zeits. f. Kryst., xii. p. 607.

This mineral differs from biotite in the possession of water and a smaller percentage of potassium. As Hoppe-Seyler[1] found that when biotite is subjected to the action of carbon dioxide and water it loses potassium and gains water, Knop thinks that this mineral, which he calls *pseudobiotite*, may have been formed in the same way, especially as it is found most abundantly near the contact of limestone with phonolite. Knop further discusses[2] the constitution of biotite, but reaches no conclusions further than that the atomic relations of its constituents are $SiO_2 : R_2O_3 : RO = 2 : 1 : 1.5$, corresponding to the formula $R_4''R_2'''Si_3O_{13}$.——Professor A. H. Chester[3] has recently communicated some notes on the chemical composition of a few obscure American minerals. *Fuchsite* from Aird Island, in Lake Huron, occurs in small layers and masses in a crystallized dolomite. According to Professor Chester's analysis it contains:

SiO_2	Al_2O_3	Cr_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	H_2O
45.49	31.08	3.09	trace	0.51	3.36	9.76	0.90	5.85

A pink celestite from Landsville, Oneida County, N. Y., yielded results corresponding to a mixture of 84 per cent. $SrSo_4$, 11 per cent. $BaSo_4$, and 5 per cent. $CaSo_4$. The mineral has been called *baryto-celestite*, but Professor Chester considers it more probably an isomorphous mixture of the three carbonates. In addition to the analyses given above, there are in the paper quite a number of new analyses reported, the most interesting being those of *okenite*, *scorodite*, *brochantite*, and *zinkenite*.——Igelström[4] reports the existence of a manganiferous *vesuvianite* with 4.72 per cent. of MnO.

Crystallographic News.—Chas. O. Trechman[5] describes crystals of barite from Addiewell in Midlothian, England. They are found in small brilliant crystals covering rhombohedra of pearl spar and the dull faces of an older genera of barite. The new forms detected upon them are $7P\breve{\infty}$, $\frac{3}{8}P\bar{\infty}$, $P\hat{\frac{1}{3}}$, $\frac{3}{4}P\hat{\frac{3}{2}}$, $\frac{2}{3}P_2$, and $\frac{1}{5}P\overline{\frac{11}{5}}$, $\breve{a} : \bar{b} : c' = .8152 : 1 : 1.3136$.——The examination by Hussak[6] of fluorite crystals from various localities, with reference to the question of optical anomalies, has revealed nothing definite in regard to the anomalous action in this case. He finds, however, that the structure of the mineral corresponds to the orthorhombic symmetry, with the axis of least elasticity normal to one of the cubic faces.——Mr. H. A. Miers[7] mentions orthoclase twins from the augite andesite of Kilimanjaro, in which the composition face (as well as the twinning plane) is the orthopinacoid. The crystals are bounded by the planes ∞P, $2P\bar{\infty}$, $\infty P\breve{\infty}$, and oP.

[1] Zeits. d. deuts. Geol. Ges., 1875, p. 515.
[2] Zeits. f. Kryst., xii. p. 588.
[3] Amer. Jour. Sci., April, 1887, p. 284.
[4] Bul. d. l. Soc. Fr. d. Min., ix. p. 22.
[5] Min. Mag., Dec. 1886, p. 49.
[6] Zeits. f. Kryst., xii. p. 552.
[7] Min. Mag., July, 1886, p. 10.

Miscellaneous.—Fremy[1] has succeeded in obtaining small well-colored crystals of ruby by subjecting to a red heat a mixture of alumina and minium, and also by heating to a high temperature equal weights of alumina and barium fluoride. In both cases the color was produced by the addition of small quantities of potassium bi-chromate.——Measurable crystals of quartz have been produced[2] by heating an enclosed dialysed solution of silica to a temperature of 320°. The crystals, ½ mm. in length, possessed the forms R, —R, ∝R, and in two cases $+\frac{2P2}{4}$. Tridymite was obtained by fusing pieces of very acid rocks with the powder of basalts and melaphyres.——A concretion of coarse tourmaline pegmatite in the tourmaline granite near Pisek, Bohemia, contains pseudomorphs[3] of pyrite after tourmaline.——The rare mineral langite has been found by Von Foullon[4] forming the cement of a breccia in Pockwerke, Garnstein.

ENTOMOLOGY.[5]

Observations on the Female Form of Phengodes laticollis Horn.—Entomologists will remember the interest taken, about one year ago, in the discovery that the female form of a Lampyrid[6] (*Zarhipis riversi*) was larva-like, and that the three stages—larva, pupa, and adult—differed but little. On the night of September 27, 1886, a larviform, luminous beetle was collected on one of the walks of the campus of the University of North Carolina.

Pupa State.—As the insect cast its skin only once—in the spring of 1887—after coming into my possession, this must represent its pupa state.

Description.—Length when crawling, two and three-fourths inches; width, three-eighths inch. Flattened, larviform, luminous; composed of twelve segments (exclusive of the head), tapering gently behind, and more decidedly on the three anterior segments. Chitinous plates on dorsum blackish-brown, the second to eleventh inclusive with a pair of large, light-brown, oval spots. Anal plate light brown, except a median band of blackish-brown, convex behind. First plate light brown, except a median irregular and two lateral blackish-brown spots. Below each stigmata, on the fourth to eleventh segments inclusive, are two longitudinal folds, the anterior half of each fold

FIG. 1.—*Phengodes laticollis*, showing luminosity.

[1] Comptes Rendus, civ., 1887, p. 737.
[2] Chrustchoff, Neues Jahrb. f. Min., etc., 1887, i. p. 205.
[3] E. Döll, Verh. k. k. geol. Reichs., 14, p. 350. [4] Ib., 1886, p. 464.
[5] This department is edited by Prof. J. H. COMSTOCK, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.
[6] Am. Nat., xx. 648. See also Ent. Am., iii. 203.

blackish-brown, shading into light brown in the middle, and becoming yellowish-white, with an olive tinge on the posterior half. Posterior edge of each dorsal plate dark olive-brown; the posterior angles of the pro-, meso-, and meta-thoracic plate and the anterior third of the pro-thoracic plate yellowish-white, tinged with olive. On the fifth to ninth segments inclusive (ventral surface) are one pair each of small, elongated, black dots, corresponding very nearly in position with the pairs of luminous organs of the ventral surface. Anal proleg blackish-brown above, yellowish-white below.

Besides the stigmata on the fourth to eleventh segments, there is one on the ventral surface of each anterior corner of the meso-thoracic segment; also two pairs of small dorsal spiracles, one each between the fourth and fifth, and fifth and sixth segments.

Thoracic legs brown, suffused with yellowish-olive. Tarsi two-jointed; single claw curved. Anterior edge of femur with a row of short hairs; under edge of tibia and first joint of tarsus with a similar row of hairs; under edge of last joint of tarsus with small, short papillæ. Head black, 2½ mm. in width, retractile. Mandibles curved, sickle-shaped, black. Antennæ four-jointed; labial palpi two-jointed (or three-jointed? Those of a larva collected in July appear three-jointed); maxillary palpi four-jointed.

The location and form of the phosphorescent lights are as follows: On each side is a row of circular ones, one on each segment from the second to the twelfth inclusive. Each of these is nearly one-eighth inch in diameter, and situated in the posterior end of the upper longitudinal fold. The posterior edge of each segment, from the second to the twelfth inclusive, emits a band of light. On the under surface are five pair, mere points, one pair each on the fifth to ninth segments.

The general appearance is that of a worm beautifully illuminated with bluish-white lights, which are disposed in a longitudinal row on each side, and in transverse bands. (See Fig. 1.)

The insect was placed in a small, elongated vial, so that I might easily observe and exhibit the display of lights. The light was brilliant until 11 P.M. on the night of September 27. At 2 A.M. the 28th the phosphorescence had disappeared. It did not appear again until the night of the 30th, when, by disturbing the insect, the lights began to glow, but continued only for a few hours. For a few nights within the space of a week I observed that the insect glowed only when disturbed. After that the posphorescence reappeared, and I do not believe once disappeared again until it was placed in alcohol, June 16, 1887.

October 1, 1886, I placed it in a glass jar of earth. It made a cell in the earth next the side of the jar, where I could observe the phosphorescence, and where it remained (excepting one warm day in February, 1887, when it came to the surface, and

returned at night when I placed the jar in a cooler place in my room coiled up until the 15th of April. At that time the luminosity was becoming more brilliant and the brown color was disappearing, to be replaced by a uniform cream color.

I removed the earth from above the cell and took the insect in my hand. It immediately straightened and began crawling. When placed in the jar it sought its cell and there remained. Instead of returning the earth I placed a glass over it, so that I might observe the beautiful display of light. It was so strong that I could read print by it when the letters were one-eighth inch long. About the 1st of May it cast its skin and became of a uniform cream color, lighter on the sides and ventral surface and between the segments of the dorsum.

Every night it came from its cell and wandered about the jar, probably striving to attract its mate. May 8 I took it out of doors at night, and placed it on the ground for about fifteen minutes. Nothing was attracted. Twice I took it in the daytime,—the 10th and 12th of May,—but nothing was attracted.

May 19 I placed it, with another (collected by Professor Holmes), in a large, open, glass jar, with about one inch in depth of earth. This I partly sunk in the earth in the open woods just at dusk. At nine o'clock the same evening I visited the place and saw a male within the jar. When it left its mate I caught it.[1] In the following morning I found another male outside the jar. The following night I captured two more males. During the day the females remained beneath the surface of the earth.

The luminosity in this case is decidedly of sexual significance, attracting the males at night. Mr. Rivers concluded that the luminosity of the female *Zarhipis riversi* was not of sexual significance, as males were attracted by day. He was at a loss to account for its utility.

Soon after meeting with the males the females became less active, and the luminosity, though plainly visible, was less in brilliancy. About June 4 they made each a cell in the earth and began depositing eggs. One deposited about twenty, and the other about thirty-five. The eggs are dull whitish in color, 3 mm. to 4 mm. in diameter. This, I believe, is the first instance on record of the eggs of any of the *Phengodini*. The female is coiled up in the cell while depositing the eggs, and afterwards lies coiled up on them. They are then very weak, and soon die. Can it be that the parent yields its dying or dead body as the first meal for its young? One which was found in September, 1886, was taken from the eggs when nearly dead and placed in alcohol. The eggs of this one proved infertile. The mouth parts, and especially the legs, were very much atrophied, and description was wellnigh impossible. In general appearance the adult is very much like that of the larva and pupa. The two

[1] Determined by Professor Riley as *Phengodes laticollis* Horn.

which I observed did not, however, resume the dark-brow color, but remained of a uniform pale-cream color, lighter o sides, under parts, and between the segments of the dorsum.

Occasionally during the adult state the one which I kept through the winter showed signs of luminosity on the pro-thoracic segment, but mainly shone as represented in Fig. The other one exhibited no sign of luminosity on the pro- and meso-thoracic segments. Otherwise it was like Fig. 1. Professor Riley, seven years ago, figured a similar phosphorescent insect,[1] and in the paper, read before the Washington Entomological Society, he says that one found by him in 1869 was figured in Le Baron's fourth Illinois report.

The males are insignificant when compared to the females in size and beauty. They are 15 mm. to 20 mm. in length. Antennæ plumose, and half, or more than half, as long as the body. The elytra are short, thin, and subulate.—*Geo. F. Atkinson, University of North Carolina, Chapel Hill*, July 7, 1887.

ZOOLOGY.

The Irish Marine Fauna.—The *Proceedings of the Royal Irish Academy* (vol. iv. of the second series) contains two preliminary reports on the marine fauna of Ireland. One is by Prof. Alfred Haddon, and treats of the fauna of Dublin Bay. The other is the report of the Committee on the Marine Fauna of South-western Ireland, and gives an account of their explorations, the different groups being treated by specialists, in a manner similar to that adopted by the Liverpool committee. There is abundant room for similar work on the American shores, but the policy of centralization adopted by the United States Fish Commission has a discouraging effect.

Von Lendenfeld on Sponges.—Dr. R. von Lendenfeld has an extensive paper on the "Position and Classification of Sponges" in a recent part of the *Proceedings of the Zoological Society of London*. His views on most points are similar to those of Vosmaer. On account of the absence of a cœlom, he regards them as true members of the Cœlenterata,—a group which he divides into two phyla, Mesodermalia, embracing the sponges, and Entothelaria, including the true Cœlenterates of other authors. He regards the mesoderm of the sponges as a modification of the mesogloea of the Cœlenterates, and homologous with it. His definition of the Mesodermalia is "Cœlenterata with permeating canal-system, and organs developed from the cells of the mesogloea, or primary mesoderm. No movable appendages." The phylum has but a single class, Spongiæ, which is subdivided as follows:

[1] American Entomologist, vol. iii.; new series, vol. i., 1880, p. 202.

I. Sub-Class Calcarea.
  1. Order Calcispongiæ.
    i. Sub-Order Homocœla, with the families Asconidæ, Homodermidæ, and Leucopsidæ.
    ii. Sub-Order Heterocœla, with the families Syconidæ, Sylleibidæ, Leuconidæ, and Teichonidæ.
II. Sub-Class Silicea.
  1. Order Hexactinellida.
    i. Sub-Order Lyssacina, with the families Euplectellidæ, Asconematidæ, Rossellidæ, and Hyalonematidæ.
    ii. Sub-Order Dictyonina, with the families Farreidæ, Euretidæ, Melittionidæ, Coscinoporidæ, Tretodictyidæ, and Meandrospongidæ.
  2. Order Chondrospongiæ.
    i. Sub-Order Tetraxonia, with the families Rhizomorinidæ, Anomocladinæ, Tetracladinidæ, Corticidæ, Pachystrellidæ, Plakinidæ, Oscarellidæ, Geodidæ, Stellettidæ, Theneidæ, Tetillidæ, and Tethyopsyllidæ.
    ii. Sub-Order Monaxonida, with the families Tethydæ, Sollasellidæ, Spirastrellidæ, Suberamatidæ, and Suberitidæ.
    iii. Sub-Order Oligosilicina, with the families Chondrillidæ and Chondrosidæ.
  3. Order Cornacuspongiæ.
    i. Sub-Order Halichondrina, containing the families Spongillidæ, Homorhaphidæ, Heterorhaphidæ, Desmacidonidæ, and Axinellidæ.
    ii. Sub-Order Keratosa, with the families Spongidæ, Aplysinidæ, Hircinidæ, Spongelidæ, Aplysillidæ, and Halisarcidæ.

These families and major groups are all characterized, as are also the sub-families recognized. In each the more important genera are mentioned. The article concludes with a nearly exhaustive bibliography of the literature of recent sponges, no less than sixteen hundred and fifty-four titles being enumerated. The latest bibliography previous to this (that of D'Arcy Thompson, 1883) contained five hundred and fifty-one titles. In this connection the student should consult the *errata* given by Von Lendenfeld in the *Zool. Anzeiger*, No. 254.

Note on the Ctenidium of Unio aberti Conrad.—In January of the present year a gentleman resident in Kansas sent me several living specimens of *Unio aberti* Conrad, just then collected in Fall River, in that State. One of these specimens proved to be a female, the ctenidia of which were surcharged with developing young. It was particularly interesting, however, because of a modification of the branchial uteri, which has been hitherto noticed but once in any species of *Unio*.

Dr. Lea, in a paper read before the American Philosophical Society in early November, 1827, described both the shell and soft parts of *Unio irroratus*, a species then first made known. This paper was published, with figures, in vol. iii., *Transactions American Philosophical Society*, Plate V., 1827. The general physiological character of the ctenidium, as thus peculiarly modified, appears to have been fully understood by Dr. Lea, but its structural relation appears to have been misinterpreted and to have been regarded as an appendage of the branchiæ, and hence as being morphologically distinct. He thus writes, pages 270–271, *loc. cit.*: "In those I observed an appendage, in form of a depressed cone, attached to the branchiæ on either side, and a very slight examination fully satisfied me these were the oviducts. . . . The long sacks containing the ova are inserted about half-way up the branchiæ and somewhat posterior to the centre. The number of these sacks in my three specimens consists of eight in two and seven in the other." In Fig. 1 is given a copy of Mr. Lea's figure of this structure, seen in external view.

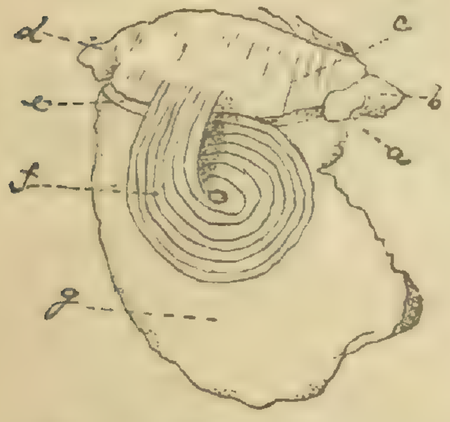


FIG. 1.—Explanation: "*a*, mouth; *b*, great anterior muscle; *c*, superior right branchiæ; *d*, great posterior muscle; *e*, inferior right branchiæ; *f*, right oviduct; *g*, foot."

Now, it is evident that these "sacks" instead of being appendages to, are really the elongated chambers of the ctenidia, functionally active as brood-pouches. The properly so-called oviducts of *Unio* is not well known, though the position of the genital opening leading from the gonads—whether they be ovaries or spermaries—is well known. The terms oviduct, as used by Mr. Lea, and ovaries, as commonly applied to the surcharged ctenidia are, therefore, not only incorrect but misleading.

Hitherto the peculiar feature noticed in *Unio irroratus* has not been found in any other species in the genus, but it now finds an instructive counterpart in Conrad's species. As shown in Fig. 2, the anterior chambers of the ctenidium, *i*,—all of which are filled with young,—are directed ventrad and backwards in a flowing curve; but as the median chambers become filled they are recurved and thrown outwards. This recurving gives to the ctenidium the appearance which Mr. Lea described as a "depressed cone." The final result is an irregular intercoiling and crowding of the more posterior chambers, which are less than one-half the diameter of the anterior ones. The chambers are without exception, very long cylindrical distally closed tubes with a somewhat less diameter at point of origin than at extremity. Their walls, which are exceedingly thin and readily ruptured, are further somewhat protected by a transparent and

somewhat gelatinous membrane, which invests the entire ctenidium and serves to aid in holding the chambers in place.

In this specimen the young found in the anterior chambers were in a more advanced stage of development than were those in the most posterior chambers. It would appear that the ova are discharged through the genital opening into the innermost branchial cloaca and pass thence, being fertilized *in transitu* and moving with the cœlomic fluids, into the outer cloaca, whence they fill the chambers, often distending them to four and five times their normal diameter. Furthermore, in nearly if not quite all the species of *Unio* which have come under our personal observation, the anterior median chambers of the ctenidia appear to be first charged with ova. The process continues, successively extending towards the posterior extremity of the outer branchiæ until, in most if not all species, both nearly entire external ctenidia function as brood-pouches. My observation has been that the process of development is, to a certain degree at least, independent of temperature conditions, for I have taken specimens of *Unio* at all seasons of the year with the young in all stages of development.

FIG. 2.—Explanation: *Oe*, œsophagus. The triangular labial palps have been removed. *ad*, anterior adductor muscle, in transverse section. *f*, foot. *i*, cylindrical chambers of the ctenidium. *ip*, excurved portion of medial chambers. *h*, siphonal tentacles. *g*, mantle, folded on itself above, to show junction of ctenidium.

It may not be out of place here to note that no byssus organ, such as is found in the glochidium larva of *Anodonta*, has ever been observed by me in the examination of numerous embryonic forms of many species of *Unio*. The byssus which is seen in certain related species—*e.g.*, *U. rubellinus*, *U. acutissimus*, *U. conradianus*, *U. parvulus*, and *U. penicillatus*—is gelatinous in nature and not chitinous, and lasts, at least in the Coosa and Cahawba Rivers, throughout the life of the individual.

An unfortunate duplication of species on the part of the writer ought, perhaps, to be mentioned here. In 1850, in *Proc. Phila. Acad. of Natural Sciences*, vol. v. p. 10, Mr. T. A. Conrad described *Unio aberti*, from the Verdigris River, Arkansas. The final description, with figures, appeared in the *Jour. Phil. Acad. Natural Sciences*, 2d series, vol. ii., Pl. XXIV., Fig. 1 (1851). Two

years later, in 1852, Dr. Lea described the same form under the name of *U. lamarckianus*, with figures, in the *Trans. Am. Phil. Soc.*, 2d series, vol. x., Plate XVII., Fig. 20. His figure is imperfect in that the characteristic roughened surface with more or less depressed folds is not shown, though mentioned casually, in the description. This circumstance, added to the fact that then I had not seen either the description or figure of Conrad's species led me into the error of redescribing in 1885, as new, this same species under the name of *U. popenoi*, the specimens coming from the Fall and Verdigris Rivers, Kansas. *Vide* "Bulletin Washburn Coll. Lab. Nat. Hist.," vol. i. No. 2, pp. 48, 49, Pl. II. 1885. There is no reasonable doubt, however, but that the last described form is the female of *U. aberti*,—Conrad's description and figure being based upon the half-grown male form. The synonymy will therefore stand as follows: *Unio aberti*, Conrad (1850). *Unio lamarckianus*, Lea (1852). *Unio popenoi*, Call (1885). —*R. Ellsworth Call.*

Zoological News.—WORMS.—Miss A. M. Fielde, of Swatow, writes to the Philadelphia Academy (*Proceedings*, p. 115, 1887) describing some observations made on the life-history of a Chinese liver-fluke. One snail examined by her was the host of at least ten thousand young Distomæ, while another individual had the liver almost wholly replaced by a Redia of the same parasite.

Mr. A. G. Bourne gives (*Proc. Zool. Soc. London*, 1886 [1887]) a preliminary account of some Indian earth-worms belonging to the families Perichætidæ and Moniligastridæ. Eight belong to the genus Perichæta, one to Perionyx, and seven to Moniligaster. The species of Perionyx (*P. saltans*) has the power of leaping into the air when touched. Bourne says that the huge earthworm mentioned by Darwin as occurring on the Nilgherries turns out to be a species of Moniligaster described by Perrier as *M. deshayesii*.

The first part of the fourth volume of Bronn's "Klassen und Ordnungen der Thierreichs" has appeared. The volume will be written by Dr. A. Pagenstecher. The present part gives an historical account of the literature of Vermes, and contains three plates illustrative of the Dicyemidæ, the figures being taken mostly from the papers of Whitman and Van Beneden.

CRUSTACEA.—Bernhard Rawitz has a paper (*Arch. f. mikr. Anat.*, xxix.) on the green gland of the crayfish. The article treats wholly of histology, and contains no comparisons or morphological suggestions. The most important point brought out is that the gland consists, in reality, of two (not one) convoluted tubes, the two uniting a short distance behind the external opening of the common duct.

FISHES.—Miss Rosa Smith has described a new species of balloon-fish (*Tetraodon setosus*) in the *Bulletin of the California Academy* (vol. ii.). It is based on a dried skin brought from Mexico.

BATRACHIA.—At the meeting of the Zoological Society of London held June 7, 1887, Prof. G. B. Howes read a paper showing that in some of the anurous Batrachia there exists a structure which appears to correspond to the mammalian epiglottis, and which, in some species, becomes well developed as an organ of voice.

REPTILIA.—Prof. O. P. Hay gives (*Jour. Cincinnati Nat. Hist. Soc.*, x. pt. 2) a preliminary catalogue of the Batrachia and Reptilia of Indiana. Seventy-seven species are enumerated.

BIRDS.—W. E. Bryant publishes, in the *Bulletin of the California Academy of Sciences*, some additions to the ornithology of Guadeloupe Island. There were previously known but eight birds from this locality, but Mr. Bryant catalogues thirty-five species and sub-species.

The ostrich in the Cincinnati Zoological Gardens is dead. Mr. Charles Dury, in an account of the death, states that the bird broke its leg in an attempt to lay an abnormal egg. The ordinary ostrich-egg measures about five by six and one-quarter inches, but this one consisted of a normal egg as a centre, and around this there were about twenty leathery layers, the whole measuring about thirteen by eighteen inches.

MAMMALS.—Dr. Ch. Lütken, of Copenhagen, states that probably the habitat of the rare *Chiropodomys penicillatus* is Java, the Copenhagen Museum having received one in spirit from Bintenzorg. He also says, on the authority of Dr. H. Winge, that the city museum of Genoa has several specimens from the same locality.

F. E. Beddard publishes an account of the visceral anatomy and the brain of the Sondaic rhinoceros in vol. xii. of the *Transactions of the Zoological Society of London*. The only previous paper on the anatomy of this species was by the late Mr. Garrod.

The second "Cunningham Memoir" of the Royal Irish Academy is by Prof. D. J. Cunningham, and treats of the lumbar curve in man and apes, as well as of the topographical anatomy of the anthropoid apes. It is illustrated with thirteen plates, some of them colored.

A preliminary notice of a paper by Oldfield Thomas, on the "Homology and Succession of the Teeth in the Dasyuridæ," appears in No. 254 of the *Proceedings of the Royal Society*. In it the author presents an outline of a scheme of homology of the teeth, into which all mammals except the Edentates readily fit.

EMBRYOLOGY.[1]

The Development of an Eight-limbed Vertebrate.—It is now some months since I communicated my suspicions to several friends that the so-called fan-tailed race of gold-fishes (*Carassius*) represented a type with four pairs of ventral limbs. Within a few days, through the courtesy of friends, I have been the surprised recipient of an admirable memoir by S. Watase, of the Imperial University of Japan, entitled "On the Caudal and Anal Fins of Gold-fishes," in which the author gives a full account of the osteology and development of the frequently double anal and caudal of the breeds "Riukin" and "Maruko," as they are known to the Japanese.

The author shows that the embryos developed a series of double ventral limb-folds extending from beneath the yelk-sac as far back as the end of the notochord and future urostyle. These folds being formed by an apparent median division of the ventral and caudal folds of the usual type seen in Teleostean embryos, the two resulting folds having shifted outwards somewhat from the median line towards the lateral position occupied by the rudiments of the anterior paired fins. This double or paired character of the ventral fold is also very pronounced in the preanal region, so that the two folds are serially continuous with the still more anterior rudiment of the "ventral" fin. The system of folds are entirely hypaxial, including even those which lead to the development of a double caudal, as in all Teleosts.

Tracing these very remarkable changes, Mr. Watase finds that the interhæmal and the small basilar interhæmal nodules supporting the rays of the anal and caudal, were repeated and paired the same as the folds in the embryos, and that even the hæmal arches of the caudal vertebræ were divergent from the median line instead of convergent towards it as in other Teleosts. In this manner both the anal and caudal paired fins are articulated by a chain of bones to the vertebral column. It is probable, however, that were the body cavity extended beyond the anus the anal pair would be severed from direct articulation with the vertebral column in the same way as the ventrals or preanal pair, where the bones of the pelvic girdle represent, according to Wiedersheim, a pair of elements derived from a series of fused interhæmal pieces.

The supports of the caudal are morphologically of the same character. There can, therefore, be little or no doubt that it is quite proper to regard the pelvic, anal, and caudal pairs of fins in the singularly modified domesticated races of gold-fishes, as serially of the same morphological value, and that if pectorals and ventrals are to be considered as limbs, the caudals and anals

[1] Edited by JOHN A. RYDER, Ph.D., Biological Department, University of Pennsylvania, Philadelphia.

must likewise, in this instance, be so considered. This type is the only vertebrate yet examined which possesses eight distinct appendages which may be legitimately considered as representing four pairs of limbs.

It is a singular circumstance that the ventral fin-folds in the embryos described by Mr. Watase are not double in the region of the anus. In every other respect these remarkable forms furnish confirmation of Dohrn's view as to the nature of the median ventral fin-fold of fishes.

Mr. Watase describes four principal types or modifications of the development of the paired fins of these interesting fishes. Upon the whole, his memoir is one of the most interesting in its bearings upon morphology of the limbs of fishes which has appeared for many years.—*John A. Ryder.*

The Inversion of the Germinal Layers in Hesperomys.—During the past summer the writer has succeeded in obtaining early stages of the embryos of *Hesperomys*, which show that the germinal layers of this American genus of myomorphs are "inverted" as in the mouse. Fig. 1 serves to show how closely they resemble the early stages of the latter as figured by Selenka. Here *s* represents the suspensor (*Träger*); *d*, the *Dotterzellen*, or outer layer; *h*, hypoblast; *e*, the epiblast, of which only that portion as far as the constriction, *c*, enters directly into the formation of the embryo. At *a* is seen the amniotic part of the cavity enclosed by the epiblast, and at *f* the secondary cavity, which at a later period is separated from the cavity of the amnion. The attachment of the blastosphere at one end by means of processes of the cells forming the outer layer of the suspensor, *s*, is well marked, and the blastosphere, as in *Mus*, *Arvicola*, and *Cavia*, is very considerably elongated. The embryonic part of the epiblast, *e*, is also thrust inwards towards the bottom or fundus of the blastosphere so as to obliterate the cavity of the yelk-sac, as in the other genera named.

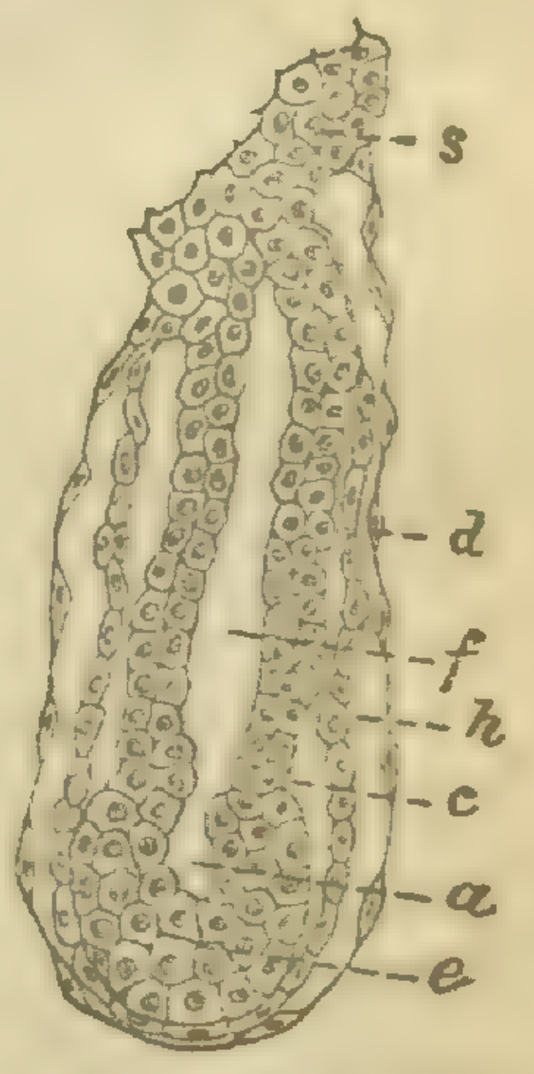


FIG. 1.

The relations of the blastosphere to the cavity of the uterus are also of some interest, as may be seen by reference to Fig. 2 (enlarged sixteen times), in which the greatly hypertrophied mucosa is represented at M, M, M, M in a cross-section of the uterus. Lying in an eccentric position in the section at *e* the minute embryo is apparent, while some distance from the embryo there is a hollow conical mass of tissue, *c*, which is part of the original epithelial wall of the tubular uterus, and is different from the much thickened and very spongy surrounding mucosa, the disposition of the lacunæ in which is indicated by the

faint radiating lines. The relations of the embryo, *e*, to the original cavity of the uterine tube is better shown in Fig. 3, showing a longitudinal section of a portion of the uterus containing a single embryo The cavity of the uterus, *u*, *u*, at either side of the region containing the embryo, is quite spacious, whereas towards the centre, *c*, of the gravid portion its lumen has been narrowed to a fine canal. On the upper or mesometric side the mucosa, M, is thinner, while on the lower side the uterine wall is much more thickened. In fact, there is evidence to indicate that the embryo, *e*, has been thrust down into the lower wall and

FIG. 2.

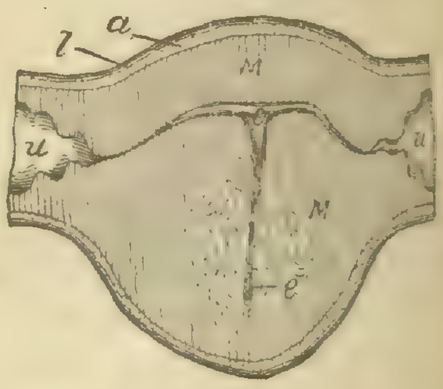


FIG. 3.

become imbedded in one of the crypts of the mucosa. That this is true is indicated by the conical or funnel-shaped passage *c*, which leads down towards the embryo from the middle of the narrowed portion of the uterine cavity, as shown in Fig. 3.

The eccentric position of the embryo in the thickened mucosa, as well as the specialized condition of the blastosphere, would favor the development of a discoidal placenta, but that the discoidal type is not the one which was characteristic of the ancestors of the *Rodentia* is, it seems to the writer, sufficiently indicated by the annular thickening of the mucosa around the embryo, for, towards the non-gravid portions of the uterine cavity at *u*, *u*, the mucosa becomes suddenly thinner. As in man, the main portion of the uterus to be first affected is the mucous lining, the muscular wall undergoing a slower and less marked change. The inner annular and outer longitudinal muscular coats of the uterus are indicated at *a* and *l* in Figs. 2 and 3; the mesometrium at *m*. The annular structure described in the preceding number of this journal is not yet well differentiated at this stage.—*John A. Ryder.*

ANTHROPOLOGY.

The Discovery of an Ancient Tomb near the Holy Sepulchre, Jerusalem.—Early in October, 1886, excavations made on Christian Street, Jerusalem, resulted in the discovery of a tomb, evidently of great antiquity, far below the pavement. Christian Street is a narrow street running northerly and southerly, to the eastward of Hezekiah's Pool, and west of the Church of the Holy Sepulchre, connecting, at its northerly extremity, with the *Viâ Dolorosa*, which last is the traditional route traversed by Christ on his way to be crucified. The tomb is situated towards the east side of the street, and is exactly seventy-two feet due west from the Holy Sepulchre. It is two and one-half feet in height, and is of rude construction, the sides being formed of large stone slabs uncemented, while it is covered with similar slabs on top.

Soon after the unearthing of the tomb I was on the spot, and made as full an examination of it as the circumstances permitted; but the careless and clumsy work of the fellaheen had injured or destroyed much of the contents. I found the base of the tomb was fifteen and one-half feet below the surface of the street; and the section made by the excavation plainly showed that the original surface of the ground was a hill-side sloping in the direction of the Tyropœon Valley. The slope and depression were filled up with an accumulation of *débris* so as to be almost obliterated or made nearly level. The *débris*, composed of all sorts of rubbish of the ancient city, above the tomb amounted to four feet in thickness, but, of course, greatly increased towards the southward or lowest part of the slope. The base of the tomb was therefore eleven and one-half feet below the original surface of the hill-side, an unusual depth, which might be taken as implying great antiquity.

Within the tomb were found two interments, one being the much-decayed bones of a man, buried with the head to the west. The other was an instance of cremation, the remains being enclosed in a cinerary urn, and consisting of calcined bones mingled with ashes and charcoal. With these were lachrymal vases of terra-cotta, several of which were broken in the exhumation; but two were taken out unfractured. Though of rather graceful shape, they are of coarse make, and resemble each other in design, except that one is about one-third larger than the other, and is ornamented with four devices or figures (perhaps an inscription) in a dark (blackish) paint or stain, which in some places is barely traceable. The body of each vase is of oval outline, with flat bottom, and contracts into a long, taper neck, with trumpet-shaped mouth. The larger is a little over six inches, the smaller about four and one-third inches, in height. I was at once struck by their close resemblance to similar vessels

in collections in Jerusalem, which have been assigned to P... nician origin, and to others brought from Cyprus; also to ... more ancient of the Cypriote pottery which I had seen ... British Museum and the Louvre, as well as in the cele... Di Cesnola collection in the American Museum, New York.

The cinerary urn, only the fragments of which have been ... by me, is of the same description of earthenware as the ... bottles or vases, but is of a redder color. It is remarkab... and fragile in proportion to its size, being about one-eigh... an inch thick.

All who have seen the tomb here described, and who ar... experience in such antiquities, unhesitatingly assign it to ... Canaanitish or Jebusite period. There can be no doubt as to ... great age.

It is insisted on by many that this discovery largely fa... the belief that the true sites of Calvary and the tomb ... Christ are not those generally accepted, but are identical w... the high knoll at the Cave of Jeremiah and the tomb ... the garden near by, outside the walls of Jerusalem, near ... Damascus Gate, they arguing that the Jews would never ... selected as a place of interment a Jebusite or Canaanitish bu... place.

Though this may not be considered as conclusive, the ... here given may be regarded not only as interesting and val... but as forming an additional link in the chain of evidence ... but surely encircling this important subject, and about wh... shall have more to say anon, having accumulated there ... much curious and determinative material, but with which I ... not prepared to deal at present. Among the testimony I m... the wonderful, massive, and extensive Roman pavements rec... brought to light in this city, and which have bearings ... case of unquestionable and significant character.—*Henry Gi... U. S. Consul, Jerusalem, Palestine.*

MICROSCOPY.[1]

Albuminized-Felt Tablets for Mounting Anatomical Pre... rations.—Anatomical preparations are usually exhibited m... on plates of glass, wax, or wood, in alcohol. For many ... —*e.g.*, whole animals—glass plates are excellent mounting ... lets, but they do not serve this purpose well in the case ... delicate preparations, such as the internal organs of inse... molluscs, etc. Wood or wax tablets are generally emp... when the parts of the preparation require to be fixed in pla... pinning; but these tablets are objectionable, inasmuch as th... are attacked by alcohol.

[1] Edited by C. O. WHITMAN, Milwaukee, Wisconsin.

H Dewitz[1] recommends felt tablets prepared in the following manner:

1. Pour the white of eggs, after separation from the yelks, into shallow plates, covering the bottom of each with a *thin* layer. Keep in a warm place for a few days, until the white becomes quite thick. If it is not to be used at once, let it dry completely, and then dissolve in cold water whenever needed.

2. Take a piece of fine, white wool-felt, of any desired size, and completely saturate it, by pressing and kneading, with the thick-ened (or dissolved) preparation of white.

3. Take two plates of thick window-glass, a little larger than the felt; warm them over a spirit-lamp, and smear one side of each with white wax,[2] rubbing the surface well with the finger or otherwise to make the coat of wax thin and even. When the wax is cool, place the piece of albuminized felt between the glass plates, in contact with the waxed sides; and then bind them together with a string so closely that no layer of air is left between the felt and the layer of wax. Plunge the whole several times into boiling water (thus avoiding breakage through too rapid expansion); then leave it in the water (kept boiling) for a quarter of an hour. After cutting the string the glass plates are easily removed, leaving the felt tablet ready for cutting to the size and shape required.

4. The tablets thus prepared should be kept in ninety-five per cent. alcohol. Before use they may be soaked a few hours in water, in case they are too hard for the use of quills or spines as pens. It is not advisable to use the tablets immediately after drying, as they only attain a proper degree of hardness after lying several days in ninety-five per cent. alcohol.

Colored tablets may be made by mixing coloring-substances with the prepared white. It is necessary, however, to select for the purpose substances that do not lose their color in alcohol. Lamp-black may be used for black, ochre for yellow, cinnabar and carmine for red.

The **white tablets** present a better appearance if they are treated with corrosive sublimate before being placed in ninety-five per cent. alcohol. The finished tablets may be stained with hæmatoxylin; but they must first be placed in boiling water to free them from any traces of wax. The stain with hæmatoxylin is often imperfect, and is therefore not to be recommended. Dewitz prefers ochre to any of the other coloring-substances above named.

After saturation with colored white it is well to sprinkle the tablet with the coloring-powder, and rub it in with the finger before bringing the tablet between the glass plates.

The foregoing method of procedure may be varied so as to

[1] Zool. Anz., x., No. 256, p 392, 1887.

[2] Instead of **wax, a thin layer of collodion may be used.**

give the white a leathery consistency. After the piece of felt has been thoroughly saturated with colored white and sprinkled freely with the coloring-powder, as before described, it is spread out on a clean glass plate and pressed down so as to leave no air-bubbles between it and the glass. It is then left to dry at ordinary room temperature. When completely dry it is removed from the glass and covered with a thin collodion solution. As soon as the collodion coat is dry the tablet is thrown into boiling water and kept below the surface by weighting for fifteen minutes. Black tablets colored with lampblack should always be made in this way, as they generally appear flecked when made by the first method.

The Reduction of Chromic Solutions in Animal Tissues corrected by Reoxidation with H_2O_2.—It is well known that the brownish-green color assumed by animal tissues under exposure to chromic solutions is due to a combination of the oxide of chromium (Cr_2O_3) with CrO_3. There is a partial reduction of the chromic acid in the tissues, resulting in the formation of Cr_2O_3, which then unites with the remaining CrO_3 to form the compound known as chromic chromate (chromsaure Chromoxyd). P. G. Unna[1] has shown that the greenish color can be removed by treating the tissues with hydrogen dioxide.

Unna explains the chemical processes involved in the following manner: "If a solution of chromic acid or bichromate of potassium be mixed with a solution of H_2O_2, a deep green precipitate of chromoxide (Cr_2O_3) is immediately formed, which combines with the remaining chromic acid to form the intermediate salt (chromic chromate) with a brownish-green color. If the mixture is left to itself, the process of reduction, after reaching a definite point, changes to one of oxidation, and the chromic chromate is soon reoxidized, leaving the solution yellow as at first. . . .

"The same phenomenon is seen when (1) sections colored by chromic acid or bichromate of potassium are placed in H_2O_2, or when (2) sections treated with H_2O_2 are immersed in the chromic solutions. The sections at once become dark green, then brownish-green, and, finally, in the first case yellow, in the second colorless.

"If the sections, at the moment when the brownish-green color appears, are removed from the solution and thoroughly washed, the color of the chromic chromate, which is not unimportant for many histological details, remains fixed."

[1] Archiv f. mik. Anat., xxx., H. 1, p. 47, 1887; *Cf.* Monatsheft f. prakt. Dermat. ii. p. 31.

SCIENTIFIC NEWS.

—Dr. N. Archer Randolph, professor in the University of Pennsylvania, was recently drowned near Atlantic City, N. J., at the age of thirty-eight years. Professor Randolph had made a number of important original researches in the physiology of digestion, and much was anticipated from his future work in this direction. His loss is a serious one from every point of view; neither science nor the community could afford the sacrifice.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

The Thirty-Sixth Meeting of the American Association for the Advancement of Science was held at Columbia College, New York, commencing Wednesday, August 10, and closing Tuesday, August 16, 1887.

The officers for the meeting were:

PRESIDENT.—S. P. Langley, of Washington. VICE-PRESIDENTS.—A. *Mathematics and Astronomy*—(William Ferrel, of Washington, was not present.) Vacancy filled. B. *Physics*—W. A. Anthony, of Ithaca, N. Y. C. *Chemistry*—Albert B. Prescott, of Ann Arbor, Mich. D. *Mechanical Science*—Eckley B. Coxe, of Drifton, Pa. E. *Geology and Geography*—G. K. Gilbert, of Washington. F. *Biology*—W. Farlow, of Cambridge, Mass. H. *Anthropology*—D. G. Brinton, of Media, Pa. I. *Economic Science and Statistics*—Henry E. Alvord, of Amherst, Mass. PERMANENT SECRETARY.—F. W. Putnam, of Cambridge (office Salem, Mass.). GENERAL SECRETARY.—W. H. Pettee, of Ann Arbor, Mich. ASSISTANT GENERAL SECRETARY.—J. C. Arthur, of Geneva, N. Y. SECRETARIES OF THE SECTIONS.—A. *Mathematics and Astronomy*—Henry M. Paul, of Washington. B. *Physics*—C. Mees, of Athens, Ohio. C. *Chemistry*—C. F. Mabery, of Cleveland, Ohio. D. *Mechanical Science*—George M. Bond, of Hartford, Ct. E *Geology and Geography*—(T. B. Comstock, of Champaign, Ill., not present.) W. F. Davis, Cambridge, Mass. F. *Biology*—J. Henry Comstock, of Ithaca, N. Y. H. *Anthropology*—F. W. Langdon, of Cincinnati, Ohio, was not present.) Vacancy filled. I. *Economic Science and Statistics*—W. R. Lazenby, of Columbus, Ohio. TREASURER.—William Lilly, of Mauch Chunk.

The following papers were read Thursday, August 11:

SECTION C—CHEMISTRY.

On the constituents of wild-cherry bark; Frederick B. Power and Henry Weimar. On the fatty acids of the drying oils; L. M. Norton. The chemical composition of the juices of sorghum cane, in relation to the production of sugar; H. W. Wiley. Percentage of ash in human bones of different ages; William P. Mason. On the occurrence in nature of a copper antimonide; T. H. Norton. A new apparatus for fractional distillation; T. H. Norton. Certain alloys of calcium and zinc; T. H. Norton. Amount of moisture left in a gas after drying with phosphorus pentoxide; Edward W. Morley. Improvement in stand for electrolysis; William Hale Herrick. A process for the separation of alkaloidal poisons, for students' use; Arthur L. Green. Causes, progress, and cure of recent great outburst of typhoid fever at Mount Holly, New Jersey; Albert N. Leeds. Some higher homologues of cocaine; F. G. Novey.

SECTION E—GEOLOGY AND GEOGRAPHY.

On the different types of Devonian in North America; H. S. Williams. The Trenton Limestone as a source of petroleum and inflammable gas in Ohio and Indiana; Edward Orton. Section of well at Morrisville, N. Y.; Charles S. Prosser.

The Upper Hamilton group of Chenango and Otsego Counties, N. Y.; Charles Prosser. A geological section at Great Barrington, Mass.; Alexis A. Julien. The granite and quartzite contact at the Aurora mine, Gogebic iron range, Ironwood, Mich.; N. H. Winchell. The Potsdam Sandstone in Southern Pennsylvania; Edgar. On the geology of New York City and environs; D. S. Martin. On recent field work in the Archæan of Northern New Jersey and Southeastern New York; N. L. Britton. On the age of the limestones of Westchester County, N. Y.; Frederick J. H. Merrill. Notes on the eruptive rocks of the Archæan in the New York and New Jersey Highlands; J. F. Kemp. Geological section of Southwestern Ohio; Joseph F. James. Notes on the Berea grit in Eastern Ohio; H. P. Cushing. The unknown geology of Illinois; T. B. Comstock. Notes on the Texas section of the American Cretaceous; Robert T. Hill.

Section F—Biology.

(No Zoological Papers were presented at the morning session, and no Botanical Papers at the afternoon session.)

Notes on the Flora of the Kittatinny Mountains; N. L. Britton. The cultivation of Cinchonas of Bolivia; H. H. Rusby. Developments of the Umbelliferæ fruit; J. M. Coulter. On the structure of the frond in *Champia parvula* Harv.; R. A. Bigelow. Apical growth in Fucus; W. G. Farlow. Study of the hairs in *Nymphæa perfoliatum*, and *Dipsacus laciniatus* in relation to insects; W. J. Beal and C. E. John. Characters of the injuries produced by parasitic fungi upon their hosts; A. B. Seymour. Notes on Catalpa leaf spot disease; Effie A. Southworth. Fungium on *Juniperus virginiana;* W. G. Farlow. On the Phengodini and their anomalous larviform females; C. V. Riley. On the morphology of the legs of hymenopterous insects; A. J. Cook. The mechanical origin of the sectorial teeth of the Carnivora; E. D. Cope.

Section H—Anthropology.

Aboriginal New York villages; W. M. Beauchamp. Recent archæological investigations in the Champlain Valley; G. H. Perkins. Study of a small isolated community in the Bahama Islands; T. Wesley Mills. On the correlation of certain mental and bodily conditions in man; Charles Porter Hart. What is? E. W. Claypole. Illustrative notes concerning the Minnesota Odjibways; M. E. Babbitt. China in America; a study in the social life of the Chinese in Eastern cities of the United States; Stewart Culin. The Serpent Mound of Adams County, Ohio, and its preservation by the Peabody Museum; F. W. P. System of symbols adapted for American Prehistoric Archæology; Wills De Hass.

Evening.—General Reception to the members of the Association and their families by the Ladies' Committee, at nine o'clock in the Metropolitan Opera House.

Friday, August 12.

Section C—Chemistry.

Report of committee on uniform method of stating the results of analysis of mineral and potable waters.

Improvement in stand for electrolysis; William Hale Herrick. On the determination of nitrogen by soda lime; W. O. Atwater. Analysis of two manganese mineral waters; Fred. G. Novy. Standardizing hydrometers; W. P. Mason. On the salts of benzene-sulphonic acid with the amines; T. H. Norton. Some new metallic salts of benzene-sulphonic acid; T. H. Norton. On the amine salts of toluene-sulphonic acid; T. H. Norton. On the action of silicon fluoride on acetone; T. H. Norton. On the limits of the direct bromination of acetone and the action between ammonium sulphocyanide and monobrom-acetone; T. H. Norton. On the action of chlorine on acenaphthene; T. H. Norton. On the urates of ammonium and the amines of the fatty acids; T. H. Norton. Some new nitrosides; T. H. Norton. Composition of Lockport sandstone; H. W. Weld. Note on the chemistry of germination; Wm. McMurtrie. Note on absorption of nitrogenous nutriment by the roots of plants; Wm. McMurtrie. The processes of soil formation

from the Northwestern basalts; E. W. Hilgard. Indirect determination of calcium; William Hale Herrick. On the delicacy of the sense of taste; E. H. S. Bailey and E. L. Nichols.

Section E—Geology and Geography.

This morning was devoted to a consideration and discussion of the report of the American Committee of the International Congress of Geologists, which was read by Dr. Persifor Frazer, Secretary. In the course of the discussion Major J. W. Powell, director of the United States Geological Survey, endeavored to have the committee enlarged, but was not sustained. A resolution approving its work was adopted.

Section F—Biology.

On the physiology of the heart of the snake; T. W. Mills. Remarks on classification; B. G. Wilder. On the morphology of the skull and the evolution of the Ichthyopterygia; G. Baur. Locomotion and bilateral symmetry; Joseph Jastrow. Remarks on the development of Pteromyzon; W. B. Scott. On the morphology of the ...; G. Baur. Observations upon the embryological development of the opossum; H. F. Osborn.

Section H—Anthropology.

History and present condition of Pre-historic Archæology in Western Europe; Thomas Wilson. Relics of an Indian hunting-ground; A. Wanner. On a gigantic adzelte votive adze from Oaxaca, Mexico; George F. Kunz. On a remarkable crystal skull; George F. Kunz. Some aboriginal dwelling sites in the Champlain Valley; D. S. Kellogg. The true basis of ethnology; Horatio Hale. On the assumed mythical character of Prof. Heer's Atlantis theory; J. Kost.

Afternoon.—At the request of Mrs. J. S. T. Stranahan, of Brooklyn, the directors of the Union Ferry Company invited the members of the American Association for the Advancement of Science to an excursion around the harbor of New York. The ferry-boat "Brooklyn" left South Ferry, and returned to same place between 6 and 7 P.M.

Evening.—The sections met at eight o'clock. Reception of the Botanical Club of the Association by the Torrey Botanical Club, in the Library Hall of Columbia College. The herbarium was open for inspection, and a collation was served in the basement of the Law School.

Saturday, August 13, an excursion up the Hudson River, to West Point, left at 9 o'clock A.M., by the steamer "New York" of the "Albany Day Line." An excursion to Long Branch started at 10 o'clock A.M., upon one of the Iron Steamboat Company's steamers, and returned at 8.30 P.M.

Monday, August 15.

Section C—Chemistry.

The significance of "bonds" in structural formulas; Spencer B. Newberry. Positive and negative units of valence; Albert B. Prescott. On chemical changes accompanying osmose in living organisms as illustrated by the oyster; W. O. Atwater. The processes of soil-formation from the Northwestern basalts; E. W. Hilgard. A new method for the preparation of anhydrous aluminium chloride; C. F. Mabery. The action of aromatic amines upon certain substituted unsaturated acids; C. F. Mabery. Constitution of the sulphur compounds in crude petroleum oils (preliminary notice); C. F. Mabery. A compound rich in carbon occurring in some plants;

Helen C. De S. Abbott. The scientific basis of the feeding of infants; Albert R. Leeds. Report of Committee on Indexing Chemical Literature.

Section E—Geology and Geography.

Section of the Lower Silurian (Ordovician) and Cambrian strata in Central New York, as shown by a deep well near Utica; C. D. Walcott. Notes on the geology of Florida; L. C. Johnson. The Upper Eocene lacustrine formations of the United States; W. B. Scott. "Lake Cuyahoga," a study in glacial geology; E. W. Claypole. The southern drift; Joseph E. Willet. Notes on the extinct thermal springs of Arkansas; Theo. B. Comstock. Sand-boulders in the drift, or subaqueous origin of the drift in Central Missouri; J. W. Spencer. Notes on the theory of glacial motion; J. W. Spencer. Glacier erosion in Norway, with some notes on northern ice-action; J. W. Spencer. The Columbia formation; W. J. McGee. The origin of the terraces along the Ohio River between Cincinnati and Louisville; John C. Branner. The southern limit of the glacial drift in Kentucky and Indiana; John C. Branner. Genesis of the Hawaiian Islands; C. H. Hitchcock. A description of two caverns near Manitou, Colorado, with maps; H. C. Hovey. Photographs of the interior of a coal mine; Fred. P. Dewey. On the monticuliporoid corals of the Cincinnati group, with a critical revision of the species; Jos. F. James and U. P. James. Discovery of fossils in the lower Taconic of Emmons; Chas. D. Walcott.

Section F—Biology.

The Cultivated Cinchonas of Bolivia; H. H. Rusby. Æcidium on *Juniperus virginiana;* W. G. Farlow. A comparison of the Epidermal System of different plants; W. J. Beal. Confirmatory evidence of *Mastodon obscurus* Leidy, as an authentic American species; R. P. Whitfield. The Buffalo-gnat problem in the lower Mississippi Valley; C. V. Riley. Origin of American Carnivora; W. B. Scott. A point in dermal physiology; with demonstration of a new æsthesiometer; Joseph Jastrow. The relation of the commissures of the brain to the information of the encephalic vesicles; H. F. Osborn. The pineal eye in extinct Vertebrata; E. D. Cope. Preliminary paper on structure of *Alosa sapidissima;* Fanny R. Hitchcock. On the homologies of Edestus; Fanny R. Hitchcock. On the early history of the foot in Prosobranch Gastropods; Henry L. Osborn.

Section H—Anthropology.

The true basis of ethnology; Horatio Hale. Sensory types of memory and perception; Jos. Jastrow. Music and poetry of the Eskimos; F. Boaz. The Palæolithic age in America; S. D. Peet. The subdivision of the Palæolithic period. D. G. Brinton. The Indians of British Columbia; F. Boaz. Totemism and animal worship; was it confined to the races who were in the hunter stage? S. D. Peet. The Serpent Mound of Adams Co., O.; F. W. Putnam. On the preservation of Aboriginal remains in America; Alice C. Fletcher.

Afternoon.—A botanical excursion to Sandy Hook gave the botanists of the Association an opportunity to examine the seaside flora, in company with the Torrey Botanical Club and the Natural Science Association of Staten Island. The Entomological Club accompanied the Botanical on this excursion.

Evening.—Reception by the Academy of Sciences.

At eight o'clock, a meeting of the New York Academy of Sciences was held in the Library Building of Columbia College for the especial purpose of welcoming the Association.

Professor Henry Drummond, of Glasgow, delivered a lecture on "The Heart of Africa," giving observations on a recent scientific tour to the region of the Zambesi and Lake Tanganyika.

After the lecture a general reception and a collation was given to the members of the Association and their families by the Academy.

The Electric Club of New York City generously tendered the

privileges of their club-house for two weeks to the members of Sections B, C, and D.

For Wednesday, an invitation was extended by the Right Rev. Bishop Potter, to those members who desired to visit the Public Institutions on Blackwell's Island.

A geological party, under the direction of Mr. George Kunz, visited the trap and sandstone exposures of the Palisades and Bergen Ridge. On their return, the party were entertained by Mr. and Mrs. Kunz at their house in Hoboken.

Lieutenant E. L. Zalinski, Fifth U. S. Artillery, invited those members who are interested in Mechanics and Physics to witness the firing of the "pneumatic" (dynamite) gun, at Fort Lafayette, on Wednesday afternoon.

The Excursion Committee was authorized by Mr. Henry Monett, Gen. Pass. Agt., to extend in behalf of the New York Central & Hudson River Railroad Co., an invitation to those attending the Association to visit Saratoga at a nominal rate.

Tuesday, August 16.

Section E—Geology and Geography.

Discovery of fossils in the lower Taconic of Emmons; Chas. D. Walcott. The plants and the fishes of the triassic rocks of New Jersey and the valley of the Connecticut; J. S. Newberry. The fossil fishes of the Cleveland shale; J. S. Newberry. The State Line Serpentine and associated rocks, a preliminary notice of the Serpentines of S. E. Pennsylvania; Fred'k D. Chester. Exhibition of a new petrographical microscope of American manufacture; George H. Williams. Some examples of the dynamic metamorphism of the ancient eruptive rocks of the south shore of Lake Superior; George H. Williams. The "Huronian" system; Alexander Winchell. Is there a diamond field in Kentucky? J. S. Diller and Geo. F. Kunz. Mineralogical notes. On the diamond found at Dysartville, N. C. Rock-crystal from Ashe Co., N. C.; Geo. F. Kunz. On the agatized and jasperized wood from Chalcedony Park, Arizona, with exhibition of magnificent specimens; Geo. F. Kunz. The relation of the pole of the land hemisphere to continents, to the magnetic system, and to seismic force; Richard Owen. Relation between geographical forms and geological formations; Richard Owen. The "slate conglomerate" of the original Huronian, the parallel of the Ogishke conglomerate of Minnesota; N. H. Winchell. The Animike black slate and quartzite and the Ogishke conglomerate of Minnesota, the equivalent of the original Huronian; N. H. Winchell. An unconformable conglomerate lying on the Marquette iron-ore rocks at Negaunee and Ishpeming, Michigan; N. H. Winchell. On the successful protection of the Egyptian Obelisk in Central Park, against the ravages of two winters, by saturating its surface with melted paraffine wax; R. Ogden Doremus. A geological section of Great Barrington, Mass.; Alexis A. Julien. The four great sandstones of Pennsylvania; E. W. Claypole. The Trenton limestone as a source of petroleum and inflammable gas in Ohio and Indiana; Edward Orton. The unknown geology of Illinois; Theo. B. Comstock. Notes on the extinct thermal springs of Arkansas; Theo. B. Comstock.

Section F—Biology.

On the histology of the vegetative organs of *Brasenia peltata* Pursh; J. Schrenk. The flora of the Amboy clays; J. S. Newberry. Honey plant oil; F. S. Pease. The honey plant; Mrs. F. S. Pease. The flora of the Potomac formation in Virginia; William M. Fontaine. Methods of branching in the fibro-vascular system of plants; A. A. Crozier. Some notes on American roses; Sereno Watson. The proboscis of the mosquito; G. Macloskie. On cataloguing microscopical preparations; R. H. Ward. On the origin, development, and prevalency of the so-called Echinococcus; C. P. Hart.

SECTION H—ANTHROPOLOGY.

On the Santhals of Northeastern Bengal; S. Kneeland. Anthropology as a study in a college course; G. H. Perkins. Some of the unsolved problems connected with the stone age, especially as to its subdivision; S. D. Peet. The Niam Niams and their neighbors; Franz Boas. Evidences of a pre-Indian occupation of New Jersey; Charles C. Abbott. Some aboriginal dwelling sites in the Champlain Valley; D S. Kellogg. The relation of archæological remains to river terraces; A. W. Butler, Preliminary studies of Platycnemic Tibiæ; Frank Baker. The philosophy of wit, humor, and satire; Melville D. Landon.

PROCEEDINGS OF THE GENERAL SESSION—Mr. J. A. Brashear, of Allegheny, Pa., brought the following voluntary contributions from friends in Pittsburg, Pa.:

William Thaw.....One hundred dollars.
C. G. Hussey.....One hundred dollars.
George Westinghouse, Jr.....Fifty dollars.
Henry Phipps, Jr.....Fifty dollars.

The following resolutions were adopted by the Association:

(1) Memorializing Congress to preserve archæological remains on public lands from destruction.

(2) Memorializing the Executive to appoint at an early day an efficient chief of the United States Coast Survey.

(3) Appointing a committee to obtain from Congress a reduction on the tariff on scientific books and apparatus.

(4) Memorializing Congress for the establishment of a bureau of standard measurements.

(5) Recognizing the importance of printing the compilation of the literature of meteorology prepared by the Signal Office.

(6) Approving and endorsing the project for erecting a monument over the remains of J. J. Audubon in New York City.

(7) Expressing regret that an invitation to meet in Toronto next year was received too late for acceptance.

The following committees were appointed:

(1) On awards of pecuniary aid for scientific research.

(2) To transmit to the Executive the resolutions relative to the United States Coast Survey.

(3) A permanent committee on transportation for the Association.

The following officers were elected to serve at the next meeting:

President, Major J. W. Powell, of Washington. *Vice-Presidents by Sections:* Mathematics and Astronomy, Professor Ormond Stone, of the University of Virginia; Physics, Professor A. A. Michelson, of Cleveland, Ohio; Chemistry, Professor C. E. Monroe, of the United States Navy, Newport, R. I.; Mechanical Science, Professor C. W. Woodward, of the Washington University, St. Louis; Geology and Geography, Professor G. H. Cook, New Brunswick, N. J.; Biology, Professor C. V. Riley, Washington; Anthropology, Professor Charles C. Abbott, Trenton, N. J.; Economic Science and Statistics, Professor C. W. Smiley, Washington. *Permanent Secretary*, Professor F. W. Putnam, Cambridge. *General Secretary*, Professor J. C. Arthur, Lafayette, Ind. *Secretary of the Council*, Professor C. Leo Mees, Athens, Ohio. *Treasurer*, William Lilly, Mauch Chunk. *Secretaries of Sections in Order*: Professor C. L. Doolittle, Bethlehem, Pa.; Dr. A. L. Kimbal, Johns Hopkins University; Professor W. L. Dudley, Nashville; Professor George H. Williams, Johns Hopkins University; Professor Arthur Beardsley, Swarthmore College; Dr. N. L. Britton, Columbia College; Professor Frank Baker, Smithsonian Institution; and Professor Charles S. Hill, Washington.

The place for the next meeting was settled to be at Cleveland, and the date will be the fourth Wednesday in August, 1888.

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THE STUDY OF A SMALL AND ISOLATED COMMUNITY IN THE BAHAMA ISLANDS.

BY T. WESLEY MILLS, M.A., M.D.[1]

SINCE the Bahama group of islands lies between 21° and 27° north latitude, it will appear that they are chiefly sub-tropical, but for the purposes of this paper they may be considered as practically tropical. The writer's experience was gathered from a residence on Green Turtle Key throughout the month of June, 1886, he having had the good fortune to make one of a party of biologists who sailed under the auspices of the Johns Hopkins University in May. It will be remembered that the Bahamas consist of several small islands without much vegetation, some thousands of rocks, and a few larger islands, the most important of which is Abaco. The majority of the keys, as the smaller islands are called, are uninhabited. Green Turtle Key, on which our party took up residence, is within about two miles of Abaco, which latter is known locally as "The Main." Green Turtle Key, about a mile in length by a quarter of a mile in greatest breadth, is the residence of some six hundred people, who are gathered together on the widest end of the island, and have formed a picturesque little village, with its streets on the solid white limestone, its alleys, its garden-plots, its shops, its school, and its churches.

The Bahamas as a whole have a common origin, as coral formations, and all the phases of the growth and changes of coral reefs and islands may be studied here. But this has

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already been done by others, and the writer purposes in this paper to attempt what he believes is a new task,—a description of the life of a small and almost wholly isolated community of Anglo-Saxons and Negroes in a tropical or sub-tropical region from the point of view of biology, psychology, and physiology (or medicine); for it seems to him that the conditions are here furnished for the solution, in great part, of certain highly interesting problems. The briefest possible glance at the history of the Bahamas will make the general treatment of the subject clearer.

Columbus, who visited St. Salvador (either Cat or Watling Island), thus wrote to Ferdinand and Isabella of the natives:

"This country excels all others as far as the day surpasses the night in splendor; the natives love their neighbors as themselves; their conversation is the sweetest imaginable; their faces always smiling; and so gentle and affectionate are they, that I swear to your Highness there is no better people in the world."

This simplicity made them a prey to the perfidious Spaniard, and forty thousand of them are said to have been transported in 1509 to the mines of Hispania.

The English visited the Bahamas in 1629, and soon took possession, on the plea of ridding them of the pirates with which they were infested. In 1718 the first crown governor was appointed, and soon after the pineapple was introduced into New Providence.

During the American war of independence many colonists took up residence in the Bahamas, bringing their slaves with them; and cotton was largely cultivated, till the entire crop was, in 1788, destroyed by the red bug. In 1834 slavery was abolished by purchase.

In 1865 blockade-running was common. Wrecking had been prevalent, but gradually declined, though it has left a decided impress on the present inhabitants.

How do the natives gain a subsistence, and what does that subsistence imply?

Abaco, though a large island, is sparsely inhabited, mostly by negroes, for "swamp fever" (malaria) in a severe form is common; Green Turtle Key is, however, free from any prevailing form of disease, as the island is, throughout, high enough to escape stagnant water. The population on this key consists of Whites, mostly of English descent, many of them retaining the characteristic accent of their forefathers, and of Blacks, the de-

scendants of the slaves of former times, in about equal proportions. The two races co-operate in perfect harmony for the general good; the Black accepting an inferior *status* in society without a murmur. The best part of the town and the more eligible dwellings are occupied by the Whites, it need hardly be said; but all mingle together in the school and the church. The principal sources of income are pineapple-culture and the sponge-fishery. The government introduced the pineapple and sold the land at a price so low that all could purchase "plantations;" so that most of the natives, whether black or white, either have, or had originally, plantations of larger or smaller size. I have been informed by a gentleman engaged in the fruit trade that about fifteen or twenty vessels are loaded, during the summer months, with the pineapple; the average value of a cargo being about two thousand five hundred dollars. This would make a total of, say, forty thousand dollars, to be distributed among six hundred people; which would give less than seventy dollars to each, even assuming that the whole was thus divided, which is not the case, since the shippers' profits are to be deducted; and the natives complain loudly of the low price given for the fruit. Reckoning that an equal amount is derived from "sponging," the total income would still be very small. It is to be remembered, too, that though bananas abound, and of cocoa-nuts there are enough, these are not exported. Of the large variety of fruit-trees growing wild, often entering into the formation of the thickets in which one now and then finds himself entangled as he roams about the key, none are cultivated, not even the orange or lemon. The palmetto, likewise introduced by the English government, now grows wild, and is used by the negroes and poorer whites for thatching their houses.

The only plant that is really cultivated, except the pineapple, is the sweet-potato and the allied yam; the potato is, in fact, the staple article of diet among the blacks and a large proportion of the whites. As the only food-animal kept on the island is the hog, of a very poor breed and in still poorer condition, fresh meat is practically unknown, while canned meat is too dear to obtain, except as a rare luxury. Fish may be caught in abundance in the open ocean a mile or two away; but this implies the possession of a boat—which all have not got—and the expenditure of a little energy, which requires more than an

ordinary stimulus, as one learns, in a tropical climate. Stoves are almost unknown; and it was with the greatest difficulty that we could secure one at an exorbitant figure. Cooking is performed in the most primitive fashion, mostly out of doors. But few fowls are kept, and fresh milk is, of course, unknown; so that milk, eggs, and meat must be practically excluded from the dietary. Nor is fruit partaken of so abundantly as might be supposed; it is reserved to sell to the sailors who visit the island during the summer months. The pilot who came aboard to take our vessel over the reef had with him an unsightly lump of what he called bread, which, however, consisted really of a heavy mass of crushed sweet-potatoes baked into a sort of cake. Indian meal seems to be largely used also, though corn is not grown.

As in other ill-fed communities, meals are very irregular. We learned on one occasion that our diver, who had been at work up till 11 A.M., had not yet partaken of any breakfast, such fasting being, he said, a frequent occurrence. On another occasion, when bringing up some corals for us, he seized the opportunity of placing half a dozen big molluscs (*Strombus gigas*) in the bow of the boat,—"for my breakfast to-morrow." These were to be chopped up and stewed with onions, etc. By the side of many a house might be seen piles of the shells of these molluscs, left to be burned for lime, furnishing that of the very whitest and best, as might be expected. Enough will have been said to show that, from a physiological stand-point, this community is in a state of partial starvation.

Though it may surprise many to learn of it, a similar condition of things constantly exists, to my certain knowledge, at a fishing station on the coast of North Carolina; nor is it probably confined to that one locality. And the opportunity of comparing these two communities, similar in many respects, each being composed of Blacks and Whites, has been most instructive, and affords a firmer basis for the conclusions to be drawn in this paper.

When one examines the housing and general hygienic condition of the people, especially of the Blacks, a state not much more satisfactory is found. The Negro families are large; the rooms in the houses few and small; bedding insufficient; and huddling the consequence. Moreover, the natives, both white and black, have a peculiar custom of closing up the doors and windows, owing, I fancy, to dread of the violent storms, which

often come up suddenly in the night, and may, in fact, work havoc in an ill-built hut before the openings can be closed. Nevertheless, it follows that the inmates must be breathing a most impure air. One might expect that, with such an equable temperature and generally favorable climate, consumption would be unknown; but I found this was by no means the case, though it is much more common among the Blacks. This is to be explained by the racial tendency of Negroes towards phthisis; and by the fact that their condition of partial starvation is exaggerated by the unhygienic surroundings of their lives, particularly the impure air they breathe for half the time.

These facts are especially instructive, and strongly impress a medical observer. The natives themselves trace consumption to "licks," meaning blows and general ill usage. Such must not be left out of the reckoning; but in this case it cannot be set down to the excessive use of alcohol, for this is, fortunately, a very rare thing in this community. This brutality among a proportion of the Negroes is really traceable to an inborn savagery that neither church nor school nor public opinion—which latter I found very weak, however, in its condemnation—has yet been able to control. It is scarcely necessary to remark that such a state of things is not confined to this community; and I only notice it as an explanation of the existence of phthisis as given by the people themselves.

But it is gratifying to add that filthiness is not associated with the rest that hygiene must condemn. The houses of the Whites are mostly whitewashed or painted white, and personal cleanliness among all classes of the people is so open to observation that the most decided impression left on the visitor is that squalor is not in this instance associated with poverty. Nor can the inhabitants of this island be considered grossly ignorant or illiterate. True, many of the older people, born in slavery, cannot read, but this does not apply to the present generation. There is a fairly good school on the island, at which both the black and the white children assemble; and a noticeable absence of artificial or supercilious distinctions prevails. There are two churches, of different denominations, sustained partially by missionary effort. Their services, both on Sundays and week-days, are well attended by the people of both races, and drunkenness and profanity may be said to be almost unknown among them.

There appears to be little social life among the people, each family living very much apart, and the church being the one common meeting-place. A lack of knowledge of and interest in the affairs of the outer world was evidenced continually. A few of the boys growing up would like to go off "to see America," that unknown land from which come the ships,—their chief source of interest and profit; but the mass of the people seems never to dream of emigration any more than if they were rooted in the rocky soil,—a condition very puzzling to the visitor at first, but plain enough on later study. The announcement that a "Yankee" (vessel) is visible on the horizon never fails to rouse the entire community. The reason is complex. First of all, the old wrecking spirit only slumbers, and is not dead. The community is ever ready for "something to turn up;" if a wreck, well; if a vessel to take a cargo of pineapples, still well; for will not the sailors want some fruit, which the poorer residents have to sell, if not to eat,—and some shells or corals? And what child has not some of these? Possibly some service to be paid for at an extravagant rate; not to mention that if the ships come not the inhabitants find their occupation gone. Everything depends on the ripening of the pineapple, which is practically certain; and the exportation of it at a fair figure, which is by no means certain; and as the prices given by the shippers for this fruit annually tend to lessen, the people are becoming poorer rather than richer. However, it has never been my lot to see poverty so disguised as on this island; the entire village presents a picturesque, neat appearance; there is no squalor whatever; cleanliness, as before stated, is a most striking feature among all classes of the community; the clothing worn is adequate for this climate, and the people appear on Sundays decently clad; yet I have not the slightest hesitation in saying that the great majority, if not all of them, have not enough to eat, in the physiological sense of not being provided with food in such quantity and of such quality as will supply the losses of the body from tissue-waste.

Further, I think this community, and especially the white portion of it, affords the clearest evidence of psychical starvation: that is to say, of lack of mental and moral stimuli. This, however, will be clearer after an examination of the climatic conditions under which they live. I had not myself been many

days in this region before certain experiences of my own and of others of our party drew my attention to the influence of climate; and I endeavored, then and since, to study the subject closely, and to get its bearings, not only on the physical but on the psychical life of human beings.

The very fact that coral animals flourish only in waters comparatively shallow, and with a temperature not falling below about 66°–68° F., suffices to demonstrate in itself how high the average and the minimum must be in the Bahamas; while records kept throughout the year show that, as a matter of fact, the temperature never does fall below the above-noted point.

It was amusing to notice the astonishment of some of the children on seeing ice, which we had brought. One of the boys, on having a small piece placed in his hand, dropped it instantly, saying that "it burned;" while nothing could induce him to put any into his mouth. The following tabular statement of the temperatures for the month of June, as taken by myself, from the 9th to the 18th, at the hours indicated, will prove instructive:

At 7 A.M.	79°,	80°,	80°,	81°,	79°,	80°,	80°,	81°,	81°, 80°.
At 1 P.M.	83°,	83°,	84°,	—	82°,	84°,	84°,	83°,	85°, 85°.
At 7 P.M.	80°,	81°,	—	—	—	—	80.5°,	81°,	82°, —
At 10 P.M.	79°,	79°,	79°,	—	—	—	81°,	80.5°,	81°, 82°.

It will be noticed that the minimum was 79°, the maximum 85°; that the variations at a certain hour for each day were very slight; that the maximum variation during the twenty-four hours was small,—in a word, that the temperature for the hour and the day and the month approximated. This, taken with the observation that there is but little variation for each month of the year, establishes the fact that we have, in the climate of the Bahamas, one substantially without change of seasons, and with a *uniformly constant high temperature*. This condition in the environment has probably more to do with explaining the facts as one finds them in this community than any other; and after noting these, and the effect of the same conditions on himself and others of the party, the writer is prepared to believe that, in spite of racial superiority, the highest results, as evidenced in the character and achievements, cannot be attained by the Anglo-Saxon in a tropical climate. This conclusion may

not be in itself entirely novel; but the writer hopes to call attention to it in a new way, and, possibly, to place it on a foundation somewhat more scientific than that on which it has hitherto rested.

A broad fact that strikes a student of the condition of things on Green Turtle Key is that the Blacks deviate much less in condition and character from what they are elsewhere than the Whites. Excepting a few of the latter, who retain the English look of vigor, most of them have the stamp of weakness and anæmia in the plainest way impressed on them; they suggest feeble plants that have had insufficient light. The Blacks are not equal to the same race in the Northern States, perhaps, but are scarcely inferior to Negroes as found in some communities in the South.

It now remains to inquire what are the causes which have led to the degeneration of this English race. First of all must be named insufficient food, in the physiological sense, combined with impure air, from the custom of closing up the houses so thoroughly at night. The influence of such factors may also be well seen in the Indians of the Canadian Northwest living on the reserves. In consequence of the same sort of partial starvation, imperfect housing, and special forms of disease traceable to the advent of the white man with his peculiar vices, these Indians are fairly melting away off the face of the earth; consumption is especially destructive.

The women of all ages on Green Turtle Key have a very weakly, and generally unhappy, look; they show the influence of surroundings more than the men, as is nearly always the case.

Now, in a tropical climate, the lungs, the kidneys, and the skin,—three of the great excretors of the waste products of the bodily activities,—work under favorable conditions; there are not the climatic vicissitudes of northern latitudes to induce sudden congestions, or to throw very unequal work on different organs; but against this must be set the relaxing effect of the climate on the alimentary canal especially; hence on this island, as in other tropical lands, the tendency to actual disease is most manifest in this part of the body; but the amount really present here I could distinctly trace to other conditions, especially the quality of the food and the lack of variety in the dietary. But even when no actual disease is present, the decided lack of vigor referred to above is to be accounted for. No explanation of the

physical condition in which the nervous system does not play a large part can be at all complete; and the higher in the scale the race of men concerned, the more this must be taken into account. The bracing influence of a climate with moderate variations of temperature has its explanation largely through the nervous system. The fact that a cold bath raises the temperature cannot be wholly explained without bringing the nervous heat-producing mechanism into the reckoning.

Now, that the nervous system of the white man must be almost constantly depressed in this community may be made evident.

When it is borne in mind that the stimuli from the arrival of ships act only during the season of fruit-ripening, and that there are "hurricane months," during which no ships dare venture across the reef, it will be plain that for the greater part of the year this little community must be in a state of mental stagnation.

To the intelligent visitor, the objects here, totally unlike those he is accustomed to in his own land, have an intense interest. But all these are, to the man or the woman who has been looking on them for a lifetime, a very old story; water and sand and white rocks, and low, thick vegetation, make a wretchedly narrow environment after all, for a lifetime. What any brain becomes depends upon its capacity to develop; which is equivalent to saying that the cortical brain-cells concerned in the highest mental processes depend for their final best development very largely on the variety and number of (afferent) nervous impulses reaching them; that is to say, again, upon the richness of the individual's experiences; so that it seems to me absolutely impossible that the highest development could be attained in such a narrow life-prison as this really is to the constant resident.

It tells more on the white than on the black man because the brain of the former is superior to that of the latter; and conversely, the very difference here to be seen shows plainly that there is a pronounced inequality in favor of the white man's brain; for the circumstances under which they live are, at least, no worse in themselves, but rather better, in the case of the white man. The latter requires, for his best development, a richer experience than the Black.

Another very pronounced feature in the character of the people is their disinclination to steady, honest work; they are ready to speculate; they are prepared for wrecks; in fact, one finds the

gambling spirit well developed. It has, indeed, its actual manifestation as such, for groups of men may be seen any evening gaming by the hour for pennies,—exactly what one might expect as the outcome of such surroundings. But the climate alone tells in the plainest way as a depressing, energy-robbing factor. Hence the people will do without fish rather than expend the necessary energy to secure the much-needed nitrogenous food. A diet largely starchy will never produce the highest things, physical or other, in any race of men.

The lack of symmetry in the men, and much more so in the women, and an equal lack of comeliness of feature and beauty of expression, call for explanation.

It is to be borne in mind that, while there have been some emigrants, there have been but few immigrants; for thirty or forty years the community has been a stable one. Among a white population that does not travel, that does not receive accessions, and numbering only about three hundred, the play of "sexual selection" must be of the most restricted kind, and with corresponding results. But this does not furnish the entire explanation, I am quite sure. Long ago, Dr. O. W. Holmes, in his own inimitable manner, struck the key-note of the solution, in that remarkable book, "Elsie Venner." "Human beauty is an agricultural product in the country, growing up in men and women, as in corn and cattle, where the soil is good. Both in city and country, the evolution of the physical harmonies which make music to our eyes require a combination of favorable circumstances, of which alternations of unburdened tranquillity with intervals of varied excitement of mind and body, are among the most important. Where sufficient excitement is wanting, as often happens in the country, the features, however rich in red and white, get heavy, and the movements sluggish."

It may be said that for that play of the physical harmonies which constitutes good health a certain amount of variety and excitement, at all events in the Anglo-Saxon and some other races, is absolutely demanded. However much of a cage or prison such an island may be for men, it is incomparably more so for women; with them the variations, the stimuli, are reduced to a sad minimum; and so the flower fadeth.

The causes of the physical and psychical degeneracy to be observed on Green Turtle Key, in the Bahama Islands, may be

thus summarized: *An inadequate diet, in the physiological sense, combined with impure air; the depressing effect, physical and psychical, of a uniformly high temperature; the influence of uncertainty in the reward of exertion, and of unfounded expectation, begetting the gambling spirit; the limited play of sexual selection; and the lack of variety in the afferent influences reaching the nervous centres (experience),—all of which can be studied especially well in this community, on account of its diversity in race composition and its comparatively isolated and stable condition.*

HORNLESS RUMINANTS.

BY R. C. AULD, F.Z.S.

(Continued from page 746.)

THE genus *Bos* is composed of a large number of animals which fall into well-defined *bubaline*, *bisontine*, and *bovine*[1] divisions. The buffaloes and bisons have to be passed over, leaving the bovines to be solely dealt with as the most typical representatives.

Bovines are divided into (1) the hump-backed, Asian or Indian, and (2) the level-backed, European or Caucasian. The former, *Bos indicus*, inhabit the more tropical regions, and are subdivided into *large* and *small* varieties, best known under the name of zebus. The latter, *Bos taurus*, inhabit the more temperate regions, and are subdivided (primarily) into *B. primigenius*, or *urus*, and *B. longifrons*, or small Celtic short-horn. These may be regarded as corresponding, as to size, respectively with the two zebu types.

The seat of the origin of the ox has been generally assigned to a part of Asia not very remote from Europe, and by a few the zebu has been regarded as the parent stock from which many or all European varieties have been derived. Andrew Murray ("Geog. Dist. of Mammals," p. 142) takes this view. He says there is no osteological difference, and steps of transition can be traced through all other breeds, the Italian being somewhat similar in color to the zebu type, and having a thickening of the shoulders indicative of a hump. Rütimeyer also seems to think that the zebu is the progenitor of the small *B. longifrons*. Darwin—and with him the majority of naturalists—regards the zebu as a spe-

[1] This word is here used in its restricted sense.

cifically distinct type. Vasey,[1] on comparing the skeletons of the zebu and common ox in the museum of the Royal College of Surgeons, London, found there was a "material" anatomical difference; the former had four sacral and eighteen caudal, the latter five sacral and twenty-one caudal, vertebræ.

"The question of polled cattle is an exceedingly difficult one," truly writes Professor Boyd-Dawkins.[2] Professor Dawkins is the first—indeed, only—distinguished scientist who has seen in this question one of scientific importance. Others have treated it in the most casual manner.

This "difficult question" is a new one, and, however treated, the style of that treatment must be somewhat original. I have, therefore, aimed simply to deal with the copious testimony in the most systematic manner, and with such sufficiency of completeness as will properly exhibit its scientific interest, importance, and value.

Zebus.—In its native habitat the zebu occurs in many different varieties and conditions. Variations principally relate to size, number of humps, color of hair, and length or absence of horns. The horns are, as a rule, particularly small ("short, stubby," and very often wanting. A peculiar tame or domesticated zebu occurs in Thibet. The color varies from red to black. Many of these are without horns, the opinion of them held by the natives being that they are "degenerated,"—strangely, the same view which some old French writers took of the Scottish polled cattle. To recompense the want of horns they have a prominent frontal protuberance, "so that it is with great difficulty they can be knocked down and killed." In the foreheads of our modern polled cattle a distinct indication of a similar growth occurs. The large zebus are red and brown in color; the middle-sized are white, blue-gray, brown, and even black. The small zebus are ashy gray in the main; they are paler on inferior portions of the body; they have the usual lop-ear character, with small or *no* horns. The lop-ear is a decidedly "hummel" character stock. The "drooping ear" among our polls, too, is sometimes distinguishable, as is also the occurrence of the loose, abortive horn attached to the skin, and pendulous. Such horns are to be met

[1] Delineations of the Ox Tribe.

[2] Letter dated "*Woodhurst, Fallowfield, Manchester*, May 12, 1886."

with among all cattle. These smaller zebus are the most familiar to observing visitors to India; they are very tractable, and are used in carriages, like the ancient polled cattle of Scythia.

I met, in 1883, a native Indian gentleman, Mr. Hassain, and I put the question, "Is there any distinct polled breed in India, recognized as such?" He said there was, in the Northwest Province; their name is "*bagoudha*;" they are of a dull white color, used for heavy traffic. He said, in reply to my query, that no particular or special care was taken so as to breed them polled; they came so themselves. He stated, however, that there was a slight horny base sometimes to be observed on the frontals of some. Other "Indians" have informed me that these polled cattle are common in the teams to be seen so numerously in Bombay and other towns. I recollect a few cattle, from the Polders of the north, that were exhibited at Paris (1878), which, except for the want of the hump and lop-ear, would otherwise be described as similar to these polled zebus found in India and Persia, etc.

The figure given by Swainson (Fig. 5) to represent his *Bos pusio*, mentioned below, would illustrate Mr. Hassain's *bagoudha* exactly. It is the white, humped, lop-eared, strange-eyed, wrinkle-faced, hornless zebu complete.

FIG. 5.

FIG. 6.—Indian Ox, or Zebu.

Jardine, who describes the zebus as occurring "either horned or without horns," figures, in the plate, in the "Naturalist's Library," vol. xii., an ashy gray zebu of the typical hornless race (Fig. 6). Other illustrations in various works, drawn by the most celebrated artists, such as Landseer, Macwhirter, and others, have depicted the same hornless zebu race fairly numerously, remarkably correctly, and true to the polled type. In the illus-

tration, "An Eastern Threshing-Floor" (Fig. 7), in Canon Farrar's "Life of Christ," the polls of the animals could hardly be better represented, or more thoroughly *mooly* or *humle* in appearance, though it cannot be claimed that they are so.

FIG. 7.

The late Professor Macgillivray, the distinguished naturalist of Aberdeen, in the *Journal of Natural History* (published at Edinburgh) for April, 1837, thus describes the zebus:

"Of the numberless varieties of the domestic ox, those peculiar to India and the east coast of Africa, formerly a race generally known by the name of zebu, or Indian ox, are among the most remarkable. They are more especially distinguished by having a large tumor or hump, chiefly composed of fat, on the back between the shoulders. Of this race there are numerous breeds, varying in size from that of our largest bulls to that of a mastiff, and disposed over Southern Asia, the islands of the Indian Archipelago, and the coast of Africa from Abyssinia to the Cape of Good Hope, in which countries it supplies the place of the common ox, being used as an article of food, as a pecuniferous animal, and as a beast of burden. In some parts of India it is also employed for riding, as well as for drawing carriages, and is said to perform a journey of thirty miles a day. Its flesh, although good, is inferior to that of the European races, but the hump is reckoned a great delicacy. It varies in color, like the other domesticated breeds, the most common tints being ash-gray, cream color, or white, but it is often red or brown, and occasionally black; some of the breeds are horned, others have pendulous or flexible horns destitute of the core or bony part, and some are entirely hornless."

Professor Macgillivray figures four races:

(1) The largest-horned race.

(2) The smaller-horned race.

(3) The smallest race.

(4) The hornless race.

W. Swainson, F.R.S., in his "Natural History of Quadrupeds," describes five types of Bovines:

"The *fourth* type appears likewise indigenous to the same continent (Asia), from whence, in fact, nearly all our domestic animals have originated. It is typically distinguished by its very diminutive size, by the almost total disappearance of the hump so highly developed in the East, and by having no horns (Fig. 5). The species is seldom seen in this country, nor do we know where a full account and figure of it is to be found; we have, however, seen it in Chinese paintings, and Major Smith assures us that an individual of the small zebu race is not larger than a hog! The name *Bos pusio* may therefore be correctly applied to this species."

To compare with the above, I quote his description of his *fifth* type:

"The first variety, the Galla ox, had horns which were extremely bulky and nearly four feet in length; in other words, nearly as long as the entire length of the *Bos pusio!* A second variety of this type was the Bornou race, of a white color, and with immense horns, which, instead of rising vertically, are couched outwards and downwards. The corneous external coat is very soft, distinctly fibrous, and at the base not much thicker than a human nail; the osseous core full of vascular grooves, and very cellular inside. The skin passes insensibly to the horny state, so that there is no exact demarcation where the one commences and the other ends."

Swainson's system of classification was peculiar. He endeavored to establish "circular" or "quinary" analogies throughout the animal kingdom. Here is his curious classification of "the genus *Bos*, the natural types":

		Analogies.	
1. *Bos scoticus*	Fierce, untamable.	Feræ.	Raptores.
2. *Bos taurus*	Pre-eminently typical.	Primates.	Insessores.
3. *Bos demaceros*	Appendages on the head greatly developed.	Ungulates.	Rasores.
4. *Bos pusio*	Stature remarkably small.	Glires.	Grallatores.
5. *Bos thersites*	Fore part of the shoulder elevated.	Cetacea.	Natatores.

Bos pusio he describes, we have seen, as hornless, and figures it so. His figure is "from a Chinese painting." Evidently so, but of which he gives no particulars.

Zebus in Other Regions.—John Lawrence (1805) says,—

"Upon the island of Madagascar, in Malabar and other parts of India, in part of Persia, in the Ukraine, Calmuck Tartary, Upper Ethiopia, and Abyssinia the bisons are of the proper, or large, species; in several of the last-mentioned countries their cattle are the largest in the world, attaining the height and size of camels. Irregular as to horns; *some entirely without*, others with the horns large, either branching or pendulous." Similar to what has been already described, and showing the wide dissemination of the zebu type.

Polled Breeds in Egypt.—The kinds of cattle in Egypt are sufficiently correctly noted by W. C. L. Martin:—[1]

"In ancient times this zebu race, as well as a race destitute of the zebu peculiarities, existed in Egypt. The figures of both are plainly delineated on ancient monuments and temples. An Egyptian painting in the British Museum represents two herds of oxen, of which the foremost in the upper compartment is distinguished by its hump and shorter horns (zebu) from the long-horned, straight-backed cattle (taurus) in the lower compartment. Perhaps, however, it was rather in Upper than in Lower Egypt that the zebu breed prevailed. such, at least, is the case at the present day. In Lower Egypt, as Burckhardt states, it is almost unknown; but it begins in Dongola, when all along the Nile as far as Sennaar no others are seen." Figs. 8 and 9 exhibit various horned races of the East and Egypt, to compare with the polled.

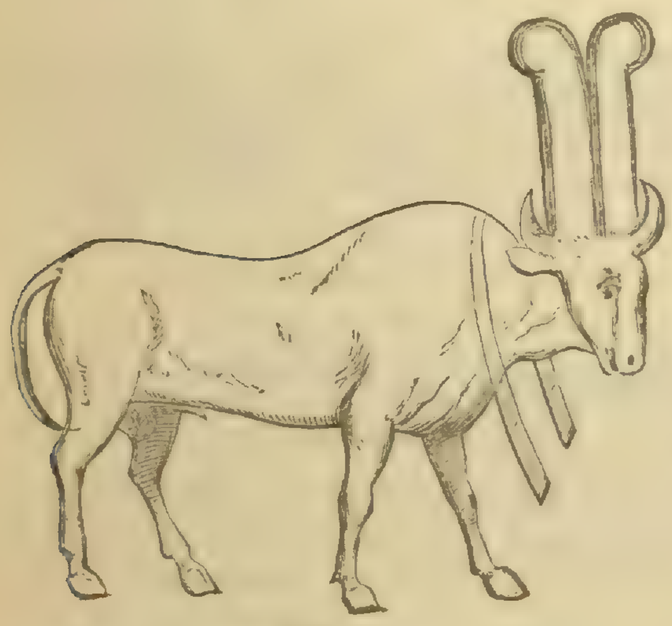


Fig. 8.

In speaking with officers and others who have been in Egypt they state they have observed representations of polled cattle on the monuments, and also some among the present existing race. Dr. E. Lewis Sturtevant has also stated "hornless cattle, *Bos*

[1] Cattle, published 1852.

taurus, are figured in herds under the fourth dynasty,"—about 2700 B.C.

Figures of these polled cattle can be seen in most works treating of Egypt. The cut given by Professor Rawlinson in his "History of Egypt" represents three animals being physicked

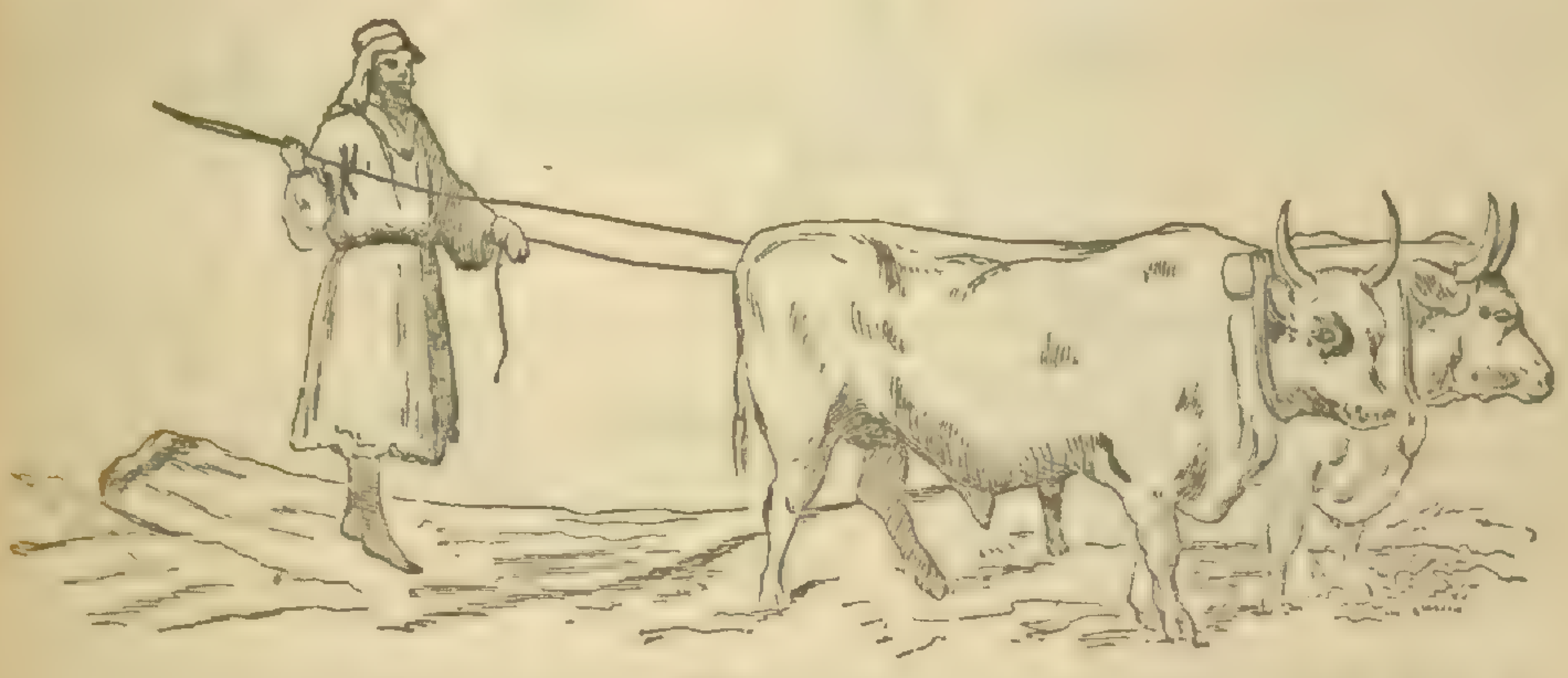


FIG. 9.

the operator not in the safest of positions), of which two are polled. Another figure is given on page 172, "Rescuing Cattle from Inundation." Two of the six are polled. Wilkinson also figures them. In vol. ii. of his work, p. 76, in the figure, "A Bull-Fight," one is polled; p. 202, "An Ethiopian Princess driven by Oxen" (Fig. 263); pp. 447, 452, also bear figures in which polled cattle may be distinguished. In that splendid work, "Description de l'Égypte, ou recueil des observations et des recherches qui ont été faites en Égypte pendant l'Expédition de l'Armée française," 2d ed., 24 tom., Paris, 1821–29, there is a volume of plates, in which representations from the monuments are given. Reliefs of polled cattle in herds, etc., are also frequently figured. This work should be seen by every one interested in the subject of the antiquity of polled cattle. Ebers's work on Egypt, more easily accessible, might be consulted by the reader.

FIG. 10.

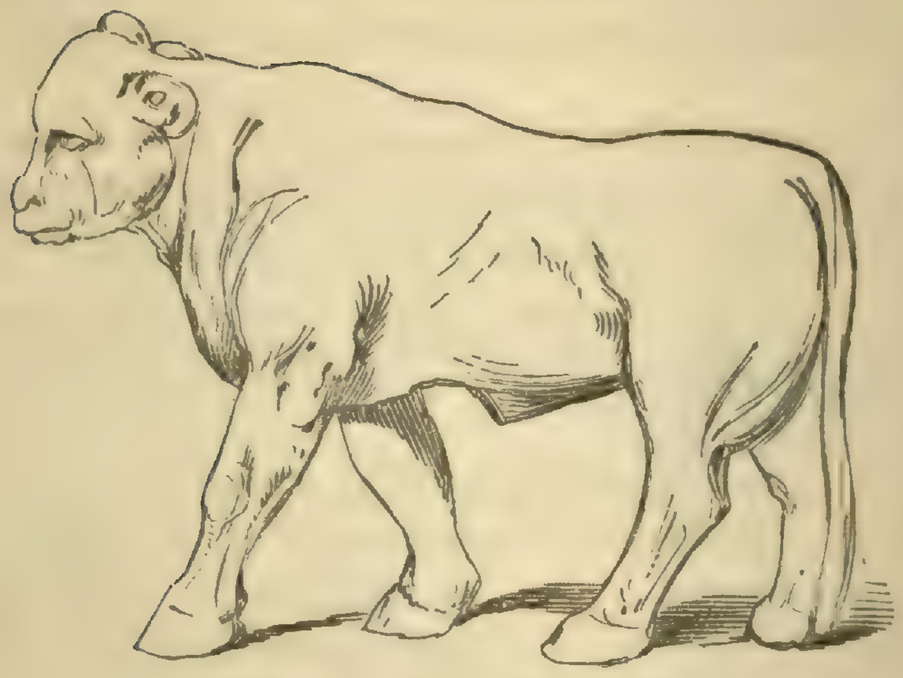


FIG. 11. (Figure in bronze.)

Rawlinson states that in Egypt "three distinct races of cattle were affected,—the long-horn, the short-horn, and the hornless." Birch ("Manners and Customs of Ancient Egyptians," by Sir J. Gardner Wilkinson, Bart.) says,—

"The cattle were of different kinds, of which three principal distinctions are most deserving of notice,—the short-horned, the long-horned cattle, and the Indian or humped ox; the last two though no longer natives of Egypt, are common to this day in Abyssinia and Upper Ethiopia."

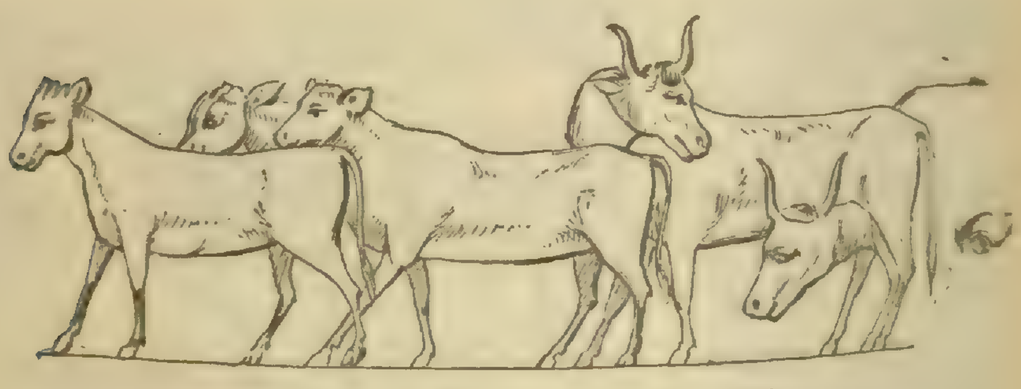


FIG. 12. (Egyptian monuments.)

In a foot-note to this he says, "A hornless variety was also known."

Cattle were domesticated in Egypt, according to Darwin, as early as 2000 B.C. Thus we have indication enough of the great antiquity of polled cattle. The Egyptians, it is supposed, were of Asiatic origin, and may have brought the progenitors of their

various breeds, including the carefully cultivated polled variety, with them.[1]

IN EUROPE.

Polled Cattle found in the Pliocene Deposits of Italy.—There is peculiar evidence of the existence of polled cattle in Europe during the Pliocene period. It was during the Upper Pliocene period that the genus *Bos* first appeared on the earth's surface. This was also the second stage in the development of deer, etc., —the period of hornless or feeble-horn rhinoceri, and of small-horned deer. Besides these, says Boyd-Dawkins, are some peculiar to Italy possessed of very remarkable characters. An ox, *Bos etruscus*, of Falconer, presents us with the first instance of polled cattle. And, on noting the "important characters of the fauna of the Pliocene period," he says,—

"It must also be remarked that the oxen (*B. etruscus*) were

[1] I may give a glimpse into the state of live-stock matters in Egypt, as may be gathered from the best sources. Dr. Samuel Birch, in his work already quoted, says beef and goose constituted the principal part of the ancient food throughout Egypt; and by a prudent foresight, in a country possessing neither extensive pasture lands nor great abundance of cattle, the cow was held sacred, and consequently forbidden to be eaten; and thus the risk of exhaustion, or at least greatly lessening their stock, was effectually prevented, and a constant supply maintained for the consumption of the people. That a considerable quantity of meat was served up at those feasts to which strangers were invited is evident from the sculptures. Plutarch says red oxen were lawful for sacrifice, but not so if they had a single white hair (compare Numbers: "Bring thee a red heifer without spot"). For the table the Egyptians killed cattle with black or red spots.

Agriculture held a high place in Egypt. As agriculturists they were adepts. They were wonderfully aided by the overflowing of fruitful Nile. The peasant ranked, however, above the *pastor*, or herdsman. The "herds," indeed, were an inferior class, and were, as individuals, looked down upon. The rich landed proprietors possessed large flocks and stocks of cattle, sheep, and goats, etc., on their estates. The denomination of pastor did not extend to the farmers who bred their own sheep or cattle; merely to those who herded them. The herds were looked over by the superiors of the estate; and they fully understood the different stages of grazing and stall-feeding. These stewards selected their shepherds, who held a responsible post. Such as were skilled in cattle-management were chosen "to make them rulers over the cattle." Nothing was neglected. Branding was an annual operation. The royal cattle were branded or tattooed on their rumps with their regular numbers, as, "Palace, 86," etc.

In some parts the herds of cattle grazed on common pasturages, and were liable to be mixed. Hence this branding, which became imperative. It was, indeed, an annual "*rounding up*,"—which has thus a most respectable antiquity. Illustrations of all these operations are found on the monuments, which are a perfect pictorial record of these wondrous ancient times, handed down to us in an imperishable form.

sometimes devoid of horns, as may be seen in a specimen pointed out to me by Dr. Forsyth Major, in the Museum of Florence. And this is his comment: "It seems very likely that horns were originally a mere sexual character peculiar to the males, and transferred, like other sexual characters, ultimately to the females. This was brought about before the beginning of the Pliocene age, since all the oxen of that period possessed horns. If this view of the origin of horns be accepted, it is easy to explain the singular ease with which, in a comparatively short time, the horns have been bred off some of our domestic cattle by selection carried on through a few generations; and our polled cattle may be looked to as a reversion to an ancestral type. The small size also of the tusks of the domestic hog, compared with those of the wild boar, may be explained in the same manner."[1]

Falconer describes *B. etruscus* ("Pal. Mems., vol. ii. p. 481) as "so peculiar as to distinguish it very remarkably from *Bos primigenius* and *Bos priscus* (the bison). It is of much smaller size, and, I suspect, constitutes a distinct undescribed species, for whose designation *Bos etruscus* would appear appropriate."

Darwin, who only touches incidentally on the subject of hornless ruminants, makes reference to the skull of this hornless *B. etruscus*, seeming to regard it as that of a female.

Figures of Polled Cattle on Greek and Roman Coins, B.C. 400.—The Greek and Roman (*fac-simile*) coins in the British Museum are arranged in such a manner as to afford a synoptical view, at once historical and geographical, of the gold and silver coinage of the ancient world, from the invention of the art of coining (about B.C. 700) down to the Christian era.

In the first compartment, relating to the First Period, circa B.C. 700–480, or the period of Archaic Art, ending with the Persian wars, in the third (geographical) section,—coins of Italy, Sicily, the southern shores of the Mediterranean, and Western Europe,—is No. 30, described thus in the catalogue:

"30. Messana ℞. [argentum]. *Obvs.* Head of lion, facing. *Rev.* MESSENION. Calf's head. Wt. 267.1 grs. After the taking of Miletus, B.C. 494, a band of Samians sailed to Sicily, and, under the advice of Anaxilaus of Rhegium, seized the city of Zancle. Anaxilaus soon afterwards sent a mixed colony to Zancle, and changed its name to Messana. The Samian types

[1] Early Man in Britain.

of this coin show that it dates from this period, circ. B.C. 490–480." The head of the so-called calf is distinctly *polled* (Fig. 13).

In the second compartment, relating to the Second Period, circa B.C. 480–400,—the period of Transitional and Early Fine Art to the end of the Athenian supremacy,—in the first (geographical) section, displaying the coins of Asia Minor, Phœnicia, Syria, etc., and Egypt, is No. 28 (Fig. 14), described in the catalogue thus:

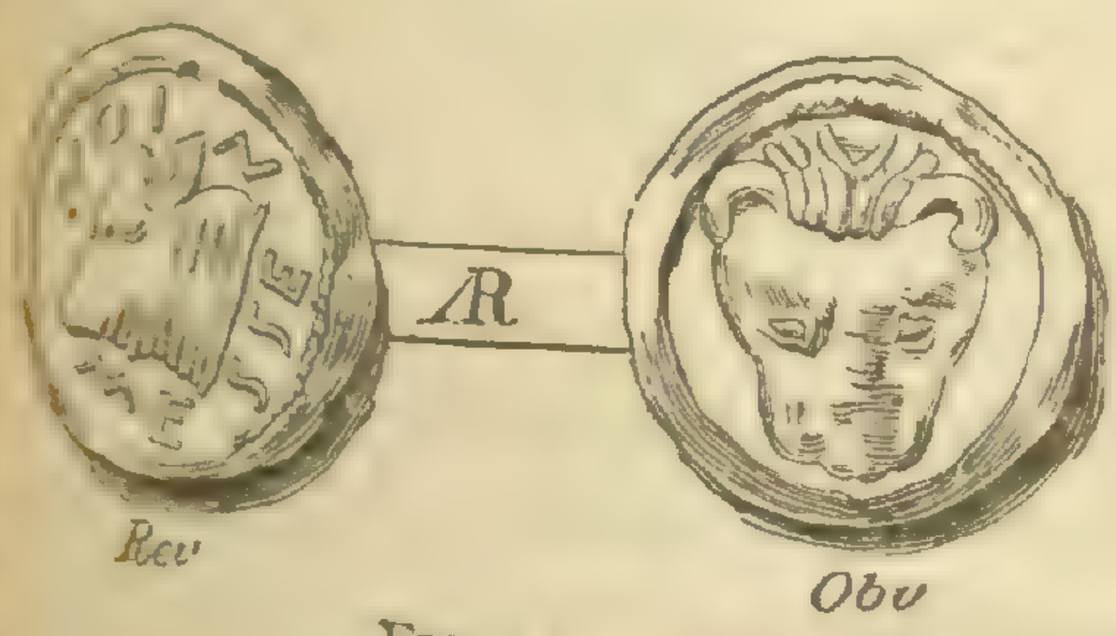


FIG. 13.

FIG. 14.

"28. Mytilene AR. *Obvs.* Two calves' heads, face to face; between them a tree. *Rev.* Incuse square. Wt. 169 grs. This coin, in spite of its globular form, is not of archaic work; neither is the metal pure. It seems, therefore, to belong to the latter part of the fifth century." The heads are distinctly *polled* (Fig. 14).

In compartment seven, relating to the Seventh Period, circa B.C. 100–1,—the period of late Decline of Art, age of Mithradates the Great, and of Roman dominion, in the second (geographical) section, displaying coins of Northern and Central Greece, the Peloponnesus, and the islands of the Ægean, is No. 26, described in the catalogue:

"26. Roman AV. [aurum], aureus. *Obv.* CAESAR. Head of Augustus. *Rev.* AVGUSTUS. Bull. Wt. 123 grs. This coin may have been struck B.C. 27. Some of the coins here assigned to Greece may have been struck in Asia." The bull is a beautiful picture of a polled animal. The head could not be more distinct, or finer done (Fig. 15).

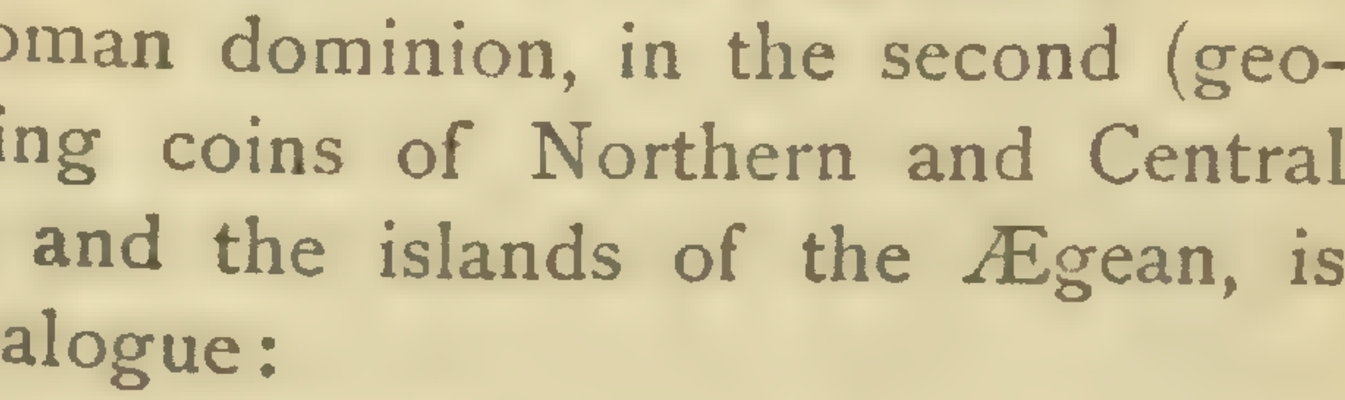


FIG. 15.

Any one who examines these *fac-simile* coins in the British Museum must be at once impressed, when cattle are represented,

with the remarkable distinctiveness given to the depiction of the horns where these had to be represented. (Figs. 16, 17, 18

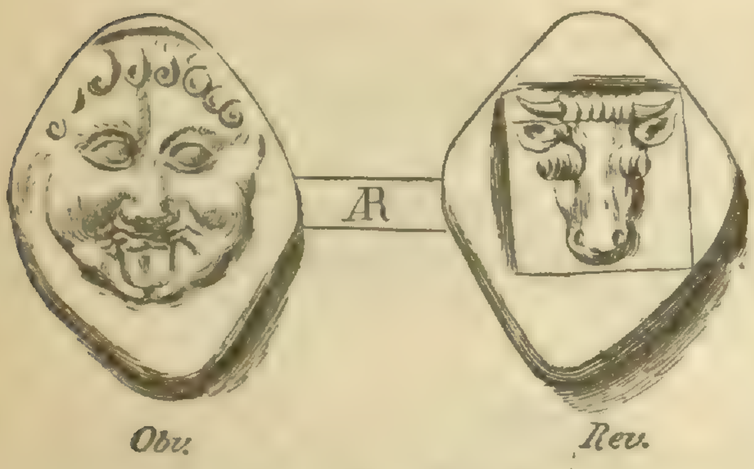


FIG. 16.

FIG. 17.

The horns are so distinct and perfectly done that any instance where they are absent is all the more valuable. All the heads have picked out are decidedly hornless, and were thus assured meant by the original artist. The last coin, marked with an asterisk (*), is represented in the last autotype plate which illustrates the octavo edition of the catalogue, to be had at the Museum.

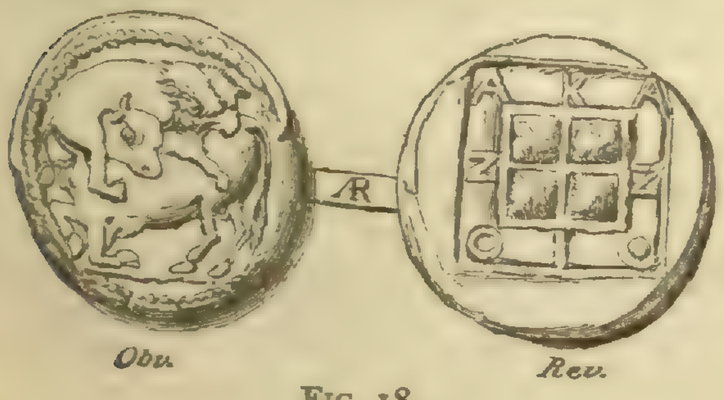


FIG. 18.

Mentioned by Herodotus B.C. 400.—The father of profane history, in describing the cattle of the Arimaspi, a one-eyed race of men, who the Issedones themselves affirmed dwelt beyond them, towards the north of Scythia, says ("Melpomene," v. 28, 29) that "it was on account of the intolerable winter of eight months of this country that the race of cattle appear to be imperfect, and not to have horns; and the following verse from Homer, in his 'Odyssey' (B. iv. 1, 85), confirms my opinion as to the cause:

'And Libya, where the lambs soon put forth their horns,'[1]

rightly observing that in warm climates horns shoot out quickly but in very severe cold the cattle either do not produce them

[1] Cowper's translation:

. . . "the coasts
Of Libya, where the lambs their foreheads show
At once their horns—defended soon as yeaned."

all, or, if they do produce them, they do so with difficulty. Here, then, such are the effects of cold." Beloe, too, has this note: "Hippocrates, speaking of the Scythian chariots, says they are drawn by oxen which have no horns; that the cold prevents them having any." Strabo also mentions these ancient polled cattle.

Herodotus's opinion as to the cause of hornlessness has been accepted by many writers down to modern times. At first sight it seems true enough, that in the northern European regions we have polled or defectively-horned animals, while in the south we see immense-horned races; but exceptions are prominent: in the palmated horns of the female reindeer of Arctic regions,—a sex in deer that is always hornless in all other climes; in the polled cattle of Southern Europe; and in the no-horn or small-horned zebu of India.

If, as is believed, the Scythians, like the Egyptians, were of Asiatic descent, this fact has its significance.

In Poland.—It would appear that it is Oliver Goldsmith, in his "Animated Nature," whom subsequent English writers, such as Lawrence, 1805, follow in the statement that "the large polled breed of England was probably derived from Poland." The word "large" used by Goldsmith is valuable evidence in connection with the idea held in some quarters, that all polled cattle occur among the small cattle. It is in the Forest of Bialowiza, in Poland, that, under the special protection of the Czar, the wild "European bison" (*Bos priscus*) is preserved. This is the Aurochs or Ure ox of the Germans, and the Urus of Cæsar. Professor Low ("Domestic Animals of Great Britain") refers to a description of an ancient writer, who speaks of these Uri of the woods of Poland as black, with a white ridge along the chine.

Mentioned by Tacitus and others.—Major Hamilton-Smith, in Griffith's elaborate edition of Baron Cuvier's "Animal Kingdom," has this passage:

"Breeds with small and middle-sized horns exist in the Crimea, in a great part of Germany, Sweden, France, England, Scotland, Italy, Spain; and the hornless cattle—originally, as it would appear, a German breed, 'ne armentis quidem aut gloria frontis,' according to Tacitus—have spread to Iceland and Norway, where they are fed on dried fish. They are now abundant in Scotland,

exist in France, and about Penaranda, in Spain, from which they may have been transported to form the polled breed of Assumption, in Paraguay. They also are common in Madagascar and Abyssinia."

Froude, the historian, in his essay on Martin Luther, 1883, in relating the memorable appearance of the reformer at the Diet of Worms, where "he gave his answers" first in Latin and then in German, Eck requiring of him a plain answer, "yes or no without horns." The taunt roused him, and he replied, "I will give you an answer which has neither horns nor teeth." This passage may be taken as evidence of the knowledge or presence of polled animals in Germany in those times.

The polled cattle of Germany are extinct. H. von Nathusius, in reply to my inquiry, says,—

"We have no polled cattle in Germany, but I remember them in Norway, and I think they are found also in the Russian provinces bordering the Genesa Sea."

Victor Hehn, in a lately published work of great erudition,[1] heads his chapter on "cattle," "The Buffalo,"—certainly a rather antiquated view, which might be excused in such a writer as Headley, mentioned later, but hardly in Hehn. He also notes the disappearance of the German polled cattle:

"The *Bos* family was the first friend of man when emerging out of barbarism, and found its modifications through the migration of nations. . . . The wholly nomadic tribes brought new races of cattle with them into the districts in which they settled. . . . The three races of the South Russian steppes—a classical cattle region—are the deposits left by as many nomadic invasions. . . . The second South Russian species, small and red, are descendants of the old Scythian breed, of which Herodotus says that they were 'stumpy-horned,' and Hippocrates that they were 'hornless,' therefore resembling the small German cattle, of which Tacitus writes that they lacked 'the glory of the brow.' . . . The hornless cattle have now entirely disappeared in Germany, but they are still to be met with in Scandinavia, whence, during the middle ages, they spread to the White Sea."

In Austria.—In Austria there is a well-known breed of red polled cattle. It has been known from time immemorial, and has been preserved by Prince Lichtenstein on his estates. Some

[1] The Wanderings of Plants and Animals from their First Home.

of the Norfolk and Suffolk breed—also red and polled—have been taken thence to infuse new blood. Some of the Austrian agricultural journals have also advocated for this purpose the introduction of the Aberdeen-Angus, which came so prominently before their notice at the Paris International Exhibition in 1878. These red polled cattle of Austria are very interesting, and we are able to produce, from the most direct source, some information about them of the greatest interest.

We are indebted to the exertions of the Chevalier Walcher de Moltheim, ministerial counsellor, director of Prince Lichtenstein's estates. In a letter dated Vienna, I Bank Street, 9, February 5, 1886, he says,—

"I send you herewith enclosed the letter I wrote you some time ago, but which I did not mail because the answers I received appeared to me to be unsatisfactory and in many points obscure. I have caused later and more comprehensive inquiries to be made; but the result of the same was also unsatisfactory, as I did not learn anything further than I had already said in my letter,"—which is as follows (translation):

"The reports I could obtain about hornless cattle in Austria were delayed, and are now as follows:

"At the manor of Radim, in Bohemia, which belongs to his Highness the Prince of Lichtenstein, hornless cattle were produced in the year 1840, through the removal (to Radim) of the regular Bern breed, of red color, from the manors which the Prince owns in Moravia; and it is proved that this new breed derives its origin from his own breed of hornless cattle. This breed was then continued at the manor of Radim with great care, and indeed with good success, up to the year 1878, when the whole stock of hornless cattle had to be killed on account of a pulmonary disease. The production of hornless cattle showed a great constancy in this respect, that, even in those cases where, on account of the lack of hornless bulls, horned bulls were employed, hornless calves were still the result.

"In the course of years his own breed had, by great carefulness, reached a high degree of improvement.

"In the year 1868 three cows and one bull of English breed were bought for the stall at Radim; but I have not been informed to which British breed these unhorned animals belonged. But these cattle also were affected by the pulmonary trouble.

"In the year 1868, before the purchase of the English animals, the stock of hornless cattle at the domain of Radim was as follows: six bulls, twenty-six cows, and two calves.

"Most of these cattle were of red or brownish-red color; one

single calf was black, sired by a Dutch bull upon an unhorned Bern cow.

"The weight of the three-year-old cows was eight hundred Vienna pounds, and thence in rising proportion to the ten-year-old cows, which were from one thousand to one thousand and forty Vienna pounds; bulls, nine hundred to thirteen hundred and twenty pounds. They were kept for the purpose of milk production, which latter amounted, in 1868, to from one thousand and seventy to fourteen hundred and nineteen Vienna quarts per cow.

"As intimated before, this breed was extinguished in 1878 at the prince's domain. Through the admission of bulls from Radim, the miller Moravek, at Tecek, possesses at present still two head of unhorned cattle.

"These are the only facts I can give now in answer to your request. Touching the bodily peculiarities, I can only add that the hornless cattle of home production retain the color, build and peculiarities of the breed.

"The head is long and narrow, loins strong, skin thin and elastic; hair soft, shining, and close; the bone structure fine, but strong; neck and shoulders strong and full. Though small of stature, the animals were of exceeding beauty."

In France.—Major Hamilton Smith has mentioned the existence of polled cattle in France; and it is stated that at Rambouillet in-and-in breeding was practised among the celebrated cattle of that place—a white, hornless breed—with great success until they were carried off by the cattle-plague of 1815. I have seen it stated that there are still a remnant of this or some other polled race preserved at one of the French gardens.

In Holland and Bavaria.—It has been stated that the late Mr. Morison, of Bognie, Aberdeenshire, Scotland, brought a lot of very fine, large cows from Holland or Belgium. "These cows were much larger in size than the home polls, and they were splendid milkers. They were of all colors, and mostly polled, with the exception of a few, which had very short, thick horns. I had four of those animals in my possession for several years. Two of them were black, with white stripe on back;[1] one was brindled, and the fourth was white, with short horns. The last mentioned was the biggest in size, and the best milker of the lot, but in consequence of the color of her first calf being white she was sold."

[1] Compare with Professor Low's description of the Uri of Poland.

A settler near where I am located has stated to me that polled cattle existed in his native country (Bavaria). His grandfather and another bred them there. They were the only parties who had them in the neighborhood. It was, he said, the habit of renewing, or alternating, their stock of cattle every few years, and for that purpose his grandfather and his neighbor had resorted to a district "near Holland" for specimens of these polled cattle, which had some celebrity at that time. The name he gave them was *hornlose*,—simply the same as our *hornless*. It is interesting to note that it was the king of Bavaria who presented gold medals, through M. Dutrone, to exhibitors at the Highland Society of Scotland, 1856. The reverse of the one gained by the late Mr. McCombie of Tillyfour states it to have been for the "Propagation des *Races bovines désarmés*, à M. W. MacCombie de Tillyfour, Ecosse, Amélioration de la Race d'Aberdeen pour la laitiere," etc. The late Hugh Watson, Keillor, also was presented with one for his remarkable cow "Grannie," which raised twenty-five calves and died at the age of thirty-six years and a half,—the greatest age, I believe, recorded to which an animal of the bovine species ever attained.

In Switzerland.—Dr. Ferdinand Keller, in his "Lake-Dwellings of Switzerland," translated by J. E. Lee, 1878, among the remains identified at Lüscherz and Möringen, notes:

(1) *Bos brachyceros-longifrons*, or marsh-cow. Certain remains only lead us to conclude that they belong to the Peat cow.

To this race also probably belonged the half of the occiput of a hornless individual. The specimen indicates a very small animal, in which the occipital proportions are exceptionally high. Similar forms are said to be found in the Norwegian cattle.

(2) *Bos primigenius.* Remains of this great race seem to have been found very sparingly.

(3) *Bos frontosus.* Remains of this race are by far the most numerous, on the average; the race was smaller than our spotted cow, yet possessed its characters most completely. The bones of the extremities are smaller than those of the spotted cow are in general. *Frontosus* belongs more especially to civilization.

In Norway, etc.—They exist in the Scandinavian peninsula. According to Mr. Bert Pettersen, Norwegian consul at Dundee, polled cattle are very common in the southern parts of Norway, while in Tromsö, within the Arctic Circle, they also exist in con-

siderable numbers, as is affirmed by Mr. John Neish, Jr., of The Laws (Scotland), who was there in 1879.

In Iceland.—Uno Van Troil, M.D., in his "Letters on Iceland," 1772, says,—

"Next to fishing, the principal support of the Icelanders is the breeding of cattle. Their beeves are not large, but very fat and good. It has been reported by some, though without foundation, that there are none among them with horns; it is true, however, that they seldom have any. They keep their large cattle at home in the yards the greater part of the year, though some have places appropriated to them in the mountains, which they call *Gar*, where they send their cattle during the summer till the hay-harvest is over. They have a herdsman to attend them, and two women to milk them and make butter and cheese. It is common to meet with oxen running wild about the mountains, which are, however, driven home in autumn, as every one knows his own by a particular mark upon them."

Sir George Stewart Mackenzie, Bart., in his "Travels in Iceland," in 1810, says,—

"The cattle, in point of size, are very like the largest of the Highland sorts, except in one respect,—that those of Iceland are seldom seen with horns. As in other countries, we meet with finer cattle on some farms than others; but from observation I could make, and information I could obtain, the Iceland farmers know nothing of the art of breeding stock. The bulls are, in general, ugly, and no use is made of them till they are five years old. In rearing a bull calf no more attention is paid to him than others. Taking all the circumstances of management together, I had some reason to be surprised to find the cattle, upon the whole, so handsome. The cows, in general, yield a considerable quantity of milk, many of them ten or twelve quarts per day, and some a good deal more. Milk is usually made into what is called *skeer*, which has been already mentioned."

(To be continued.)

HISTORY OF GARDEN VEGETABLES.

BY E. LEWIS STURTEVANT, A.M., M.D.[1]

(Continued from page 833.)

COSTMARY. *Balsamita vulgaris* Willd.

THIS plant, says Bryant,[2] was formerly cultivated in gardens for the purpose of mixing with salads, and it is a pity it is not continued, as from its sensible qualities it seems superior to many aromatic plants now in credit. In England, then, it had gone out of culture in 1783. In France, however, its leaves are quite frequently used as a condiment.[3] It is a plant of very minor importance even in France. It occurs also in the gardens of Constantinople.[4] In the United States it is recorded by Burr[5] in 1863, who mentions one variety. The name alecost came from its former use in flavoring ales and beers.

Alecost, or Costmary, is called, in France, *baume-coq, coq des jardins, grand baume, herbe au coq, herbe de Sainte-Marie, menthe-coq, menthe à bouquets, menthe grecque, menthe Notre-Dame;* in Denmark, *balsam;*[3] in Germany, *die frauenmunze;* in Dutch, *tuinbalsam;* in Italy, *costo-ortense;* in Spain, *heirva de Santa;* in Portugal, *balsamita;* in Sweden, *svensk salvia;*[6] in Arabic, *balsanch, melsaneh;*[7] by the Greeks at Constantinople, *kosta.*[4] It is the *Mentha hortensis corymbifera* of Bauhin's "Pinax," 226.

CRESS. *Lepidium sativum* L.

De Candolle[8] inclines to believe this plant to be a native of Persia, whence it may have spread into the gardens of India, Syria, Greece, and Egypt, and even as far as Abyssinia. It is said by Xenophon, about 400 B.C., to have been eaten by the Persians before becoming acquainted with bread;[9] and Pliny, in the first century, speaks of the nasturtium as growing in Arabia, of a remarkable size. It finds frequent mention in the Greek

[1] Director of the New York Agricultural Experiment Station, Geneva.
[2] Bryant, Fl. Diet., 1783, 115.
[3] Vilmorin, Les Pl. Pot., 34.
[4] Forskal, Fl. Æg.-Arab., xxxii.
[5] Burr., Field and Gard. Veg., 416.
[6] McIntosh, Book of the Gard., ii. 237.
[7] Delile, Fl. Ægypt, illust.
[8] De Candolle, Orig. Des Pl. Cult., 69.
[9] Cicero, Tusc., 5, 34.

and Latin authors. It is named by Turner,[1] which indicates its presence in England in 1538, and in three of its varieties was in American gardens in 1806.[2]

Four varieties are now under culture,—the common, the curled and extra-curled, the broad-leaved, and the golden.[3]

The synonymy of these various types is as below, it being premised that the modern varieties vary somewhat in degree only:

I.

Nasturtium hortense. Fuch., 1542, 362; Trag., 1552, 82; Pin. 1561, 221; Ger., 1597, 194; Dod., 1616, 711.
Gartenkress. Roszlin, 1550, 188.
Nasturtium. Matth., 1558, 280; Lob. Obs., 1576, 107; Cam. Epit., 1586, 335; Matth., Op., 1598, 425; Chabr., 1677, 289.
Nasturtio. Pictorius ed. Macer, 1581, 75.
Nasturtium hortense commune. Bauh., Phytopin., 1596, 161.
Nasturtium hortense vulgatum. Bauh., Pin., 1623, 103.
Nasturtium vulgare. J. Bauh., 1651, ii. 912.
Common Garden Cress. Ray, 1686, 825; Vil., 1885, 207.
Garden Cress. Townsend, 1726.
Lepidium sativum. Lin., Sp., 1763, 899.
Common Cress. Stevenson, 1765; Bryant, 1783, 103; Miller's Dict., 1807.
Common Small-Leaved. Mawe, 1778.
Cresson alenois commun. Vil., 1883, 194.

II.

Nasturtium hortense crispum. Bauh., Phytopin., 1596, 161. Pin., 1623, 104.
Nasturtium hortense L. Ger., 1597, 194.
Nasturtium crispum latifolium. Matth., Op., 1598, 425.
Nasturtium crispum augustifolium. Matth., Op., 1598, 426.
Nasturtium crispum Joh. Bauhin. J. Bauh., 1651, ii. 913.
Nasturtium hortense crispum latifolium. Bauh., Prod., 1671. 44
Nasturtium hortense crispum angustifolium. Bauh., Prod., 1671. 43.
Nasturtium crispum. Chabr., 1677, 289.
Curled Cress. Ray, 1686, 825; Townsend, 1726; Stevenson 1765, 34; Bryant, 1783, 103; McMahon, 1806; Mill. Dict., 1807
Lepidium sativum crispum. Lin., Sp., 1763, 899.
Cresson frise. L'Hort. Fran., 1824; Petit. Dict., 1826.
Cresson alenois frise. Vil., 1883, 195.
Curled, or *Normandy*, and *Extra-Curled Dwarf.* Vil., 1885, 207

[1] Turner, Libellus, 1538.
[2] McMahon, Am. Gard. Kal., 1806.
[3] Vilmorin, The Veg. Gard., 1885, 207.

III.

Nasturtium. Cam., Epit., 1586, 335.
Nasturtium hortense latifolium. Bauh., Phytopin., 1596, 160; Pin., 1623, 103.
Nasturtium latifolium dioscorideum. J. Bauh., 1651, ii. 913.
Nasturtium latifolium. Chabr., 1677, 289.
Broad-Leaved Garden Cress. Ray, 1686, 825; Vil., 1885, 207.
Broad-Leaved. Townsend, 1726; Stevenson, 1765, 34; Mawe, 1778; McMahon, 1806; Mill. Dict., 1807.
Lepidium latifolium. Lin., Sp., 1763, 899.
Cresson à large feuilles. L'Hort. Fran., 1824; Petit, 1826.
Cresson alenois à large feuille. Vil., 1883, 195.

IV.

Cresson dore. Petit, 1826; Noisette, 1829.
Golden. Hort. Trans., 1826, vi. 583; Burr, 1863, 343; Vil., 1885, 208.
Cresson alenois dore. Vil., 1883, 195.

It appears as if the types of the modern varieties have not changed through culture, as three are quite ancient, and the fourth but an ordinary variation, or of a pale yellowish-green color. The curled cress seems to have been first observed by J. Bauhin, who furnished his brother, C. Bauhin, with seed preceding 1596.

The cress, gardyn cress,[1] or pepper-grass, is called, in France, *cresson alenois*, *passerage cultivée*, *nasitor*; in Germany, *garten-kresse*; in Flanders, *hofkers*; in Holland, *tuinkers*; in Denmark, *havekarse*; in Italy, *agretto*, *crescione inglese*, *cerconcello*; in Spain, *mastuerzo*, *malpica*; in Portugal, *mastruco*;[2] in Arabia, *half*;[3] in Arabic, *reshad*;[4] in Bengali, *aleverie*, *haleem*;[5] in Hindustani, *chunsee*;[6] in India, *halim*, or *chansur*;[7] in Persian, *turehtezuk*;[6] in Sindh, *ahreo*; in Telegu, *adala vitala*.[5]

CUCKOO-FLOWER. *Cardamine pratensis* L.

An insignificant and nearly worthless salad plant, native to the whole of Europe, Northern Asia, and Arctic America, extending to Vermont and Wisconsin. It has a piquant savor, and is used as water-cress. It is recorded as cultivated in the

[1] Turner's Libellus, 1538.
[2] Vilmorin, Les Pl. Pot., 194.
[3] Forskal, Fl. Ægypt-Arab., c. xvi.
[4] Delile, Fl. Æg., illust.
[5] Birdwood, Veg. Prod. of Bomb., 7.
[6] Ainslie, Mat. Med., i. 95.
[7] Speede, Ind. Handb. of Gard., 170.

vegetable-garden in France by Noisette[1] in 1829, and by Vilmorin[2] in 1883, yet, as Decaisne and Naudin[3] remark, but rarely. I find no record of its cultivation in England, but in America it is described by Burr[4] in four varieties, differing in the flowers, and as having become naturalized to a limited extent,—a fact which implies a certain cultivation. Its seed does not appear in our seed-catalogues.

The Cuckoo-Flower, or Lady's Smock, is called, in France, *cresson des pres, cresson elegant, cressonnette, passerage sauvage;* in Germany, *wiesen kresse;* in Spain, *berros de prado.*[2]

Cucumber. *Cucumis sativus* L.

The cucumber, under the form *Cucumis hardwickii* Royle, is found growing wild in the Himalaya region, and a variety (*sikkimensis* Hook) is cultivated in Nepal and Sikkim.[5] Its origin is therefore ascribed to the East Indies. It has been a plant of cultivation from the most remote times, but De Candolle[6] finds no support for the common belief of its presence in ancient Egypt at the time of the Israelite migration into the wilderness, although its culture in Western Asia is indicated from philological data as more than three thousand years old. The cucumber is said to have been brought into China from the West 140–86 B.C.,[7] and can be identified in a Chinese work on agriculture of the fifth century, and is described by Chinese authors of 1590 and 1640.[8] Cucumbers were known to the ancient Greeks[9] and to the Romans, and Pliny[10] even mentions their forced culture. They find mention in the middle ages, and in the botanies from Ruellius (1536) onward. In America they are almost coeval with the discovery, as the companions of Columbus were growing them in their gardens at Hayti in 1494.[11] Their distribution was rapid. Cartier[12] found "very great cucumbers" in cultivation by the Indians near the present Montreal in 1535, and De Soto[13] found, in Florida, "cucumbers

[1] Noisette, Man., 1829, 356.
[2] Vilmorin, Les Pl. Pot., 1883, 198.
[3] Decaisne & Naudin, Man., iv., 228.
[4] Burr, Field and Gard. Veg., 1863, 344.
[5] Cogniaux, Cucurbitaceæ in De C. Monog., iii. 498.
[6] De Candolle, Orig. Des Pl. Cult., 212; Eng. trans., 266.
[7] Bretschneider, On the Study, etc., 15.
[8] Bretschneider, Bot. Sin., 78, 59, 83.
[9] Theophrastus, Bodæus a Stapel ed., 1644.
[10] Pliny, lib. xix. c. 23.
[11] Irving, Columbus, 1859, i. 380.
[12] Cartier, Pink. Voy., xii. 652.
[13] De Soto, Florida, 44.

better than those of Spain." In Virginia they were seen by Captains Amidos and Barlow in 1584,[1] and are mentioned again in 1609.[2] In Massachusetts they were under cultivation before 1629.[3] It is not, however, certain that these references all refer to the cucumber, but other references which might be given seem sufficient to establish the fact of its early distribution on the continent of America.

Vilmorin, in his "Les Plantes Potageres," 1883, describes thirty varieties. I have seen the most, if not all, of these growing, as well as others, in number, including synonymes, of fifty-nine different names. While some of the varieties grown are but little differing, yet there is a number of kinds which are extraordinarily distinct. In pursuing my plan of treating of the origin of the types of varieties I recognize the difficulty of a very complete treatment, through my little knowledge of the wild forms, and of the species from a botanist's point of view. The following attempt, however, may be considered reliable as far as it goes:

The types of our common cucumbers are fairly well figured in the ancient botanies, but the fruit is far inferior in appearance to those we grow to-day, being apparently more rugged and less symmetrical. The following synonymy is established from the figures and descriptions:

Cucumis sativus vulgaris. Fuch., 1542, 697.
Cucumis sativus. Roszlin, 1550, 116; Cam., Epit., 1586, 294.
Cucumis. Tragus, 1552, 831; Fischer, 1646.
Cucumis vulgaris. Ger., 1597, 762; Chabr., 1677, 134.
Concombre. Tourn., 1719, t. 32.
? *Short Green.* Park. Par., 1629.
? *Short Green Prickly.* Mawe, 1778; Miller, 1807.
Early Green Cluster. Miller, 1807.
Green Cluster. Thorb., 1828.
Early Cluster of American seedsmen.
Etc.

A second form, very near to the above, but longer, less rounding, and more prickly, has a synonymy as below:

Cucumeres. Matth., 1558, 262.
Cucumis sativus. Lugd., 1587, i. 620.

[1] Smith's Va., Pink. Voy., xiii. [2] A True Decl. of Va., 1610, 13.
[3] Higginson, Mass. Hist. Soc. Coll., 1st ser., i. 118; Wood, New Eng. Prosp., 1st ed., p. 11.

Cucumeres sativi and *esculenti.* Lob., Ic., 1591, i. 638.
Cucumis vulgaris. Dod., 1616, 662.
Cedruolo. Cast., Dur., 1617, 103.
Cucumis vulgaris, viridis, and *albis.* J. Bauh., 1651, ii. 246.
Long Green Prickly. Mill. Dict., 1807.
Early Frame. Thorb., Cat., 1828 and 1886.
Etc.

The third form is the smooth and medium-long cucumbers which, while they have quite a diversity of size, yet have a common shape and smoothness. Such are:

? Cucumer sativus. Pin., 1561, 192.
Concombre. Tourn., 1719, t. 32.
? Large Smooth Green Roman. Mawe, 1778; Mill. Dict., 1807.
Long Smooth Green Turkey. Mawe, 1778; Mill. Dict., 1807.
Long Green Turkey. Thorburn's Cat., 1828.
Turkey Long Green, or *Long Green.* Landreth, 1885.
Greek, or *Athenian.* Vilmorin, 1885.
Etc.

The fourth form includes those known as English, and are distinct, from their excessive length, smoothness, and freedom from seeds, although in a botanical classification they would be united with the preceding (from which they have, doubtless, originated). They are usually quite free from spines, often smooth, and, as grown, are very straight. My synonymy for these would scarcely be justified had I not observed the tendency of the fruit to curve under conditions of ordinary culture.

Cucumis longus. Cam., Epit., 1586, 295.
Cucumis longus eidem. J. Bauh., 1651, ii. 248.
Green Turkey Cucumber. Bryant, 1783, 267.
Long Green English varieties. Vilm., 1883, 163.

The Bonneuil Large White Cucumber, grown largely about Paris for the use of perfumers, is quite distinct from all other varieties, the fruit being ovoid, perceptibly flattened from end to end in three or four places, thus producing an angular appearance. We may suspect that Gerarde figured this type in his Cucumber, which came from Spain into Germany, as his figure bears a striking resemblance in the form of the fruit and in the leaf:

Cucumis ex Hispanico semine natus. Ger., 1597, 764.
Cucumis sativus major. Bauh., Pin., 1623, 310 (excl. Fuch.).

Bonneuil Large White. Vilm., 1885, 222.
White Dutch. A. Blanc, No. 6133.

The other types of known cucumbers are those which have lately appeared under the name of Russian. I know nothing of their history. They are very distinct, and resemble a melon more than a cucumber,—at least in external appearance:

1. *The Early Russian*, small, oval, and smooth.
2. *The Russian Gherkin*, obovate, and ribbed like a melon.
3. *The Russian Netted*, oval, and densely covered with a fine net-work.

The appearance of these new types indicates that we have by no means exhausted the capabilities of this species. The *Turkie cucumber* of Gerarde is not now to be recognized under culture, nor are the *Cucumer minor pyriformis* of Gerarde and of J. Bauhin, the *Cucumis pyriformis* of C. Bauhin's "Phytopinax," 1596.

If the synonymy be closely examined it will be noted that some of the figures represent cucumbers as highly improved as at the present day. The *Cucumis longus* of J. Bauhin is figured as if equalling our longest and best English forms; the *concombre* of Tournefort is also a highly improved form, as is also the *cucumeres* of Matthiolus in 1558.

The cucumber is called, in France, *concombre*, *cocombre* (cocomber by Ruellius, 1536); in Germany, *gurke*, *kukummer;* in Flanders and Holland, *komkommer;* in Denmark, *agurken;* in Italy, *cetriolo*, *cedriuolo;* in Spain, *cohombro*, *pepino*; in Portugal, *pepino*.[1] It was called *cowcumber* by Ray in England in 1686. Called, in Greece, *aggouria;* in Slavonic, *krastavak;* in Esthonian, *kurits*, *ug gurits* or *urits;*[2] in Polish, *ogorek;* in Bohemian, *agurka;*[3] in Tartar, *kiar;* in Calmuc, *chaja;* in Armenian, *karan;* in Russian, *ogurzi;*[4] in Egypt, *khyar*,[3] *fakus;*[5] in Arabic, *kusud;* in Bengali, *susha*,[5] *sasha*, *khyira*, *kankur;*[3] in Ceylon, *rata-kækeri*, *pipingya;* in Hindustani, *keera*,[5] *khira* or *kakri;* in Persian, *kyar;*[3] in Sanscrit, *sookasa;* in Tamil, *mooloocelleri;*[5] in Japan, *akwa*, *karas uri*, *ki uri*.[6]

The cultivated cucumber was the *sikus hemeros* of Dioscorides, the *sikuos* of Theophrastus.

The *Cucumis flexuosus* L. is occasionally sold by our seeds-

[1] Vilmorin, Les Pl. Pot., 1883, 159.
[2] De Candolle, Orig. Des Pl. Cult., 210.
[3] Pickering, Ch. Hist. of Pl., 640.
[4] McIntosh, Book of the Gard., ii. 668.
[5] Birdwood, Veg. Prod. of Bomb., 156, 301.
[6] Thunberg, Japan, 324.

men to be grown as a curiosity, but it may be used for pickling. This plant was known to the herbalists, and its figures compare with those of our modern seedsmen, as, for instance:

Cucumis longus. Lugd., 1587, i. 621.
Green Serpent. Dammon Cat., 1884–85.
Concombre Serpent. Vilmorin, 1883, 166.

The fruit is characterized by its striæ, which render it at once recognizable. In Japan it is called *sjo kwa, awo uri.*[1]

Cumin. *Cuminum cyminum* L.

A small annual plant indigenous to the upper regions of the Nile, but carried at an early period by cultivation to Arabia, India, and China, as well as to the countries bordering on the Mediterranean.[2] It is referred to by the prophet Isaiah,[3] and is mentioned in Matthew.[4] Pliny[5] calls it the best appetizer of all the condiments, says the Æthiopian and the African are of superior quality, but that some prefer the Egyptian. During the middle ages Cumin was one of the species in most common use, and is mentioned in Normandy in 716, in England between 1262 and 1400, and is enumerated in 1419 among the merchandise taxed in the city of London. It is mentioned in many of the herbals of the sixteenth and seventeenth centuries, and is recorded as under cultivation in England in 1594.[6] In India the seeds form an ingredient of some curry powders and pickles,[7] and in France yet find use in cookery.[8] The seed is occasionally advertised in American seed-catalogues,[9] but is probably very rarely grown.

Cumin is named, in France, *Cumin de Malte;* in Germany *pfeffer-kummel;* in Holland, *komijn;* in Italy, *comino di Malta* in Spain, *comino;*[8] in Greece, *kumino;* in Egypt, *kammeun* in Egyptian, *thapen*, or *tapen*, or *tapn;*[10] in Arabic, *kimoon;* in Bengali, *jeera*, or *zira;* in Ceylon, *dooroo;* in Hindustani, *jeera zira;* in Malay, *jintan;* in Sanscrit, *jeruka ajaji;* in Tamil *siragum;* in Telegu, *gilakara.*[11]

[1] Kaempfer, Amœn., 1712, 811.
[2] Pharmacographia, 1879, 331.
[3] Isaiah, ch. xxviii. 25–27.
[4] Matthew, ch. xxiii. 23.
[5] Pliny, lib. xix. c. 47.
[6] Mill. Dict., 1807.
[7] Dutt., Hind. Mat. Med., 173.
[8] Vilmorin, Les Pl. Pot., 1883, 199.
[9] Vick's Cat., 1884.
[10] Pickering, Ch. Hist., 211.
[11] Birdwood, Veg. Prod. of Bomb., 40, 237.

DANDELION. *Taraxacum officinale* Weber; *T. dens leonis* Desf.

The dandelion is a modern introduction to our gardens, and all the varieties now grown can be recognized in a state of nature; and yet, on account of its popularity, and hence the forced conditions of its growth, the variations, to the careless observer, seem very great. The history of the improved dandelion may be found in full in the AMERICAN NATURALIST of January, 1886.

The beginnings of the culture of a plant must, however, be very gradual, single individuals often growing the species in gardens long before the plant receives general appreciation. Thus with the dandelion, although its culture cannot be fairly said to antedate 1836, yet Stevenson, in his "Garden Kalendar" for 1765, in England, although not directly mentioning its culture, yet implies culture by giving directions for the blanching. In China, according to Bretschneider,[1] the leaves are recorded as being eaten as a vegetable in the fourteenth century, and the plant is classed among vegetables by Li-shi-chen, a writer of the sixteenth century; but from the data given we cannot assume cultivation.

DILL. *Anethum graveolens* L.

This aromatic plant has but little use in the garden. In France the seeds are used as a condiment, and for pickling with cucumbers. In American gardens it is rather to be considered as a medicinal herb. It is commonly regarded as the *anethon* of Dioscorides and the *anethum* of Pliny, Palladius, and others. The name *dill* is found in writings of the middle ages, and it is spoken of as a garden plant in the early botanies. The variety *A. sowa* De C. is largely grown in India. In England it was called *dyll* by Turner[2] in 1538, which implies its presence at that date. It also occurs in the vocabulary of Alfric, Archbishop of Canterbury, in the tenth century.[3] It was in American gardens before 1806,[4] and seems to occur spontaneous in the far West, as its roots are used as a food by the Snake and Shoshone Indians, by whom it is called *yampeh*.[5]

[1] Bretschneider, Bot. Sin., 53, 59.
[2] Turner, Libellus, 1538.
[3] Pharmacographia, 1879, 328.
[4] McMahon, Am. Gard. Kal., 1806.
[5] Fremont's Expedition, 154; Dept. Ag. Rept., 1870, 405.

Dill, or dyll, is called, in France, *aneth*, *fenouil batard;* in Germany, *dill;* in Flanders, *dille;* in Denmark, *dild;* in Italy, *aneto;* in Spain, *eneldo;*[1] in Arabic, the plant *chebet*, the seed *chamar;*[2] in Egypt, *sjoebet;* in Yemen, *schibt;*[3] in Bengal, *suloopha*, *soolpha;* in Ceylon, *sattacooppa;* in Hindustani, *soa soie*, *soya*, *shutapoospha;*[4] in India, *shutapooshna;*[5] in Sanscrit, *sitasiva*, *missreya*, *shaleya;* in Tamil, *saddacooppie;* in Telugu, *suddapa*, *sompa-sopu.*[4]

Earth-Nut. *Lathyrus tuberosus* L.

A plant now included among vegetables for the garden by Vilmorin,[6] although he says it is scarcely ever cultivated, but the tubers are often collected from the wild plant in France. Burr[7] likewise includes this species among American garden plants, but we know not upon what authority. In 1783, Bryant[8] says this French weed was cultivated in Holland for its roots, which were carried to market; and De Candolle and Sprengel[9] say that in Siberia the tubers are much relished by the Tartars, and also are used in Germany. It scarcely can be considered seriously as a plant of culture.

The earth-nut, tuberous-rooted pea, or eatable-rooted pea, is called, in France, *gesse tubereuse*, *anette*, *anotte de Bourgogne*, *chataigne de terre*, *chourles*, *favouette*, *gland de terre*, *macion*, *macusson*, *mitrouillet*, *souris de terre;* in Germany, *erdnuss;* in Flanders, *aardnoot;* in Holland, *aardakker;* in Italy, *ghianda di terra;*[6] by the Calmucks, *sohnok;*[10] by the Tartars, *tschina.*[9]

[1] Vilmorin, Les Pl. Pot., 8.
[2] Delile, Fl. Ægypt, illust.
[3] Pickering, Ch. Hist., 323.
[4] Birdwood, Veg. Prod. of Bomb., 38, 235.
[5] Speede, Ind. Handb. of Gard., 1842, 181.
[6] Vilmorin, Les Pl. Pot., 1883, 241.
[7] Burr, Field and Gard. Veg., 1863, 103.
[8] Bryant, Fl. Diet., 1783.
[9] De Candolle & Sprengel, Phil. of Pl., 410.
[10] Pickering, Ch. Hist., 670.

(To be continued.)

REMARKS ON CLASSIFICATION OF VERTEBRATA.[1]

BY BURT G. WILDER.

MANY classifications of animals present three general features:

(*a*) An approximate conformity to the prevailing idea that the kinds or grades of groups, the "categories" of the elder Agassiz, are limited to branch, class, order, family, genus, and species, with, in some cases, the recognition of intermediate grades,—*e.g.*, sub-class, superorder, etc.

(*b*) The division of a given group into an indefinite number of subdivisions, commonly more than two,—*e.g.*, of natural objects into three kingdoms; of animals into four, five, or seven branches; of vertebrates into five or more classes.

(*c*) The frequent discrimination of groups by characters which are neither constant nor peculiar, and derived from parts like the skeleton or limbs, which are easily preserved, examined, and described,—*e.g.*, Vertebrata, Chordata, Hyostylica.

The accompanying arrangement is partial, and in several respects provisional. It accords essentially with the more recent views of high authorities, but attention is called to the following features:

(*a*) It is wholly *dichotomous.*

(*b*) Several of the divisions are based upon the conditions of the *cavities* of the *central nervous system.*

(*c*) The new names refer to characters which are *constant* and *peculiar*, so that they are not merely designatory in a conventional sense, but *etymologically* and *descriptively correct.*[2]

(*d*) The names are largely *correlated* so as to suggest their antitheses.

The writer fully appreciates the undesirability of introducing new terms, and by no means urges the adoption of any here presented excepting as expressive and convenient substitutes for phrases.

[1] Read at the New York meeting of the American Association for the Advancement of Science, Aug. 12, 1887.

[2] On this point see the writer's "Educational Museums of Vertebrates," Amer. Assoc. Proc., 1885, p. 276.

SAUROPSIDA (= reptiles and birds); mesocœle laterally extended; roof bilobate.

MAMMALIA.—Mesocœle tubular; mesocœlian roof quadrilobate, forming two pair of optic lobes.

AMNIOTA = Abranchiata = reptiles, birds, and mammals; aulic floor approximately vertical.

ANAMNIOTA = Branchiata = Amphibia + Dipnoi; aulic floor horizontal.

MICRAULICA (*aula small;* cerebral hemispheres extended vertically); = Amphibia, Dipnoi, reptiles, birds, and mammals.

MEGAULICA (aula large; cerebral hemispheres extended horizontally or undifferentiated); = Ichthyopsida—Amphibia, Dipnoi, and Branchiostoma.

MONOCŒLIA (encephalocœle single; neuron epaxal only; axon unsegmented); =Cephalochorda = Acrania = Leptocardia = Monolocularia = Branchiostoma.

POLYCŒLIA (*encephalocœle segmented;* neuron partly preaxal; axon vertebrated) = Craniata = Pachycardia = Multilocularia.

PHENOCŒLIA (*neurocœle persistent*) = metamera = Branchiostoma and other vertebrates.

CRYPTOCŒLIA (neurocœle transitory) = Ametamera = Urochorda = tunicates.

CŒLONEURA (neuron hollow) = Chordata (+ Enteropneusta ?).

STEREONEURA (nervous centre solid if present) = most "Invertebrates."

METAZOA.

Explanation of the Table.—The more comprehensive groups are below and their divisions above.

From the point representing a given group two lines diverge, forming what may conveniently be called a *furca*, or two-tined fork.

The vertical tines form part of a line of direct ascent to man. The oblique tines or branches extend to the left, and indicate groups not in the line of succession.

For convenience the furcas may be numbered from below upward, and the groups mentioned as *direct* and *oblique*, like the tines which represent them.

The only unfamiliar terms which are not self-explanatory are *mesocœle*, the cavity of the mesencephal, or segment of the optic lobes, and *aula*, the mesal division of the prosocœle, or cavity of the prosencephal. *Preaxal* and *epaxal* are synonymes of *prechordal* and *epichordal*. *Monolocularia* and *multilocularia* refer to the cardiac cavities.

For the sake of brevity the arithmetical signs +, −, and = (plus, minus, and equal) are employed.

General Features of the Scheme. Dichotomy.—The twofold division of groups is not new in practice, and is, as it seems to the writer, becoming more common,—*e.g.*, the primary division of animals into Protozoa and Metazoa in place of four or more "branches"; the primary division of vertebrates into Acrania and Craniota, and the combination of Reptiles and Birds as Sauropsida. But, apparently, there has not been hitherto a distinct recognition of dichotomy as a fundamental principle in natural classification, or an expression of doubt as to whether any group really comprises three or more equal and co-ordinate subdivisions. The writer's view may be briefly stated as follows: *In any assemblage of three or more objects, individuals, or groups, two or more of these units are more nearly related to one another than to the third or the others, indicating a primary division of the entire assemblage.* Very commonly the basis for the distinction is the presence or absence of an organ, feature, or condition, whence arise positive and negative names, like *vertebrate* and *invertebrate*, *amniota* and *anamniota*, etc.

Irrespective of special facts, then, the writer has been led to doubt the naturalness of, for example, the popular subdivision of natural objects into three co-ordinate kingdoms, *animal*, *vegetable*, and *mineral;* of the chordata into *urochorda*, *cephalochorda*, and *vertebrates;* of vertebrates into *Ichthyopsida*, *Sauropsida*, and *Mammalia*, and of mammals into *Prototheria*, *Metatheria*, and *Eutheria*. Polychotomy is probably never more than provisional, and all classification will eventually be dichotomous.

The Morphological and Taxonomic Importance of the Central Nervous System.—The superior taxonomic value of the brain and heart was insisted upon by the writer in a paper read before this association in 1875; during the last seven years, as may be seen from various publications, he has become more and more impressed with the profound morphological significance of the presence and modifications of the *cavity* of the central nervous system, the *neurocœle*.

A neurocœle persists in all vertebrates, including Branchiostoma, and is present in the early stages of all Tunicates whose development is known. So far as the writer has been able to ascertain, the central nervous system is *neither tubular nor even grooved at any stage with any "Invertebrate,"* excepting the Tunicates, and, perhaps, *Balanoglossus*.

In accordance with the prevailing tendency to utilize the skeletal parts for taxonomic purposes, the vertebrates and Tunicates have been called *Chordata*, and *Balanoglossus* has been spoken of as a *Hemichordate*. Balfour regards the notochord as "the most characteristic organ of the Chordata."

In proposing to replace *Chordata* (a word, by the way, easily mistaken for the Latin *caudata*) by Cœloneura, the writer cares less for the adoption of the term than for the admission that soft parts are not only physiologically but morphologically more significant than hard; that the neuron is more important than the axon; and that *the cavity of the one is a more substantial base for the primary subdivision of the Metazoa than is the entity of the other.*

Special Points and Queries.—Should it seem desirable to separate those Metazoa in which the nervous system is detected from those in which none has been detected, it would only be necessary to interpolate between furcas one and two a fork, the two tines of which should stand respectively for *Neurica* and *Aneurica*, or equivalent terms; the Neurica would then comprise the Cœloneura and the Stereoneura.

The name *Vertebrata* is used only as a synonyme; if retained, there should be an understanding as to whether it shall exclude Branchiostoma, or include that form, or include the Tunicata as well.

Among the members of the oblique division of the fourth furca the Ganoids and Teleosts should be combined as fishes or Pisces, and distinguished from each other by the persistent and considerable cavities of the olfactory lobes with all Ganoids. Notwithstanding the writer's supposed observation (*Amer. Nat. Proc.*, 1876, 258), these cavities are absent or insignificant in all Teleosts examined.

The association of the Amphibia with the Dipnoi is in accordance with the considerations presented in the writer's paper on the brain of *Neoceratodus*; see this journal, June, 1887, p. [illegible].

The characterization of the mesocœlian roof of the Sauropsida as *bilobate* may need qualification in view of Spitzka's observations on the interoptic lobes of some reptiles.

The primary division of the Mammals should, perhaps, be into the Eutheria and the others (implacentals). Something is to be said for either view, and it is to be hoped that the [illegible]

diagnosis implacentals, prepared by alinjection, may be carefully compared with each other and with those of representative Eutheria.

Historical Note.—It is proper to add that the idea of recognizing two antithetical groups according to the presence or absence of a neurocœle, was first formulated by the writer, under the names *cœlianata* and *acœlianata*, on a slip dated November 12, 1883; *cœlomcura* and *stereomcura* are dated April 3, 1885. The passage on page 416 in Bell's "Comparative Anatomy and Physiology" (Philadelphia, 1885), commenting on the presence of a cavity in the nervous axis of chordata, was first seen March 14, 1886; but in January of that year, in lectures to students, and in a letter to Prof. J. H. Comstock, the general scheme of a dichotomous classification was presented in substantially the form here given.

SAND-BOULDERS IN THE DRIFT, OR SUBAQUEOUS ORIGIN OF THE DRIFT, IN CENTRAL MISSOURI.[1]

BY J. W. SPENCER, M.A., PH.D., F.G.S.

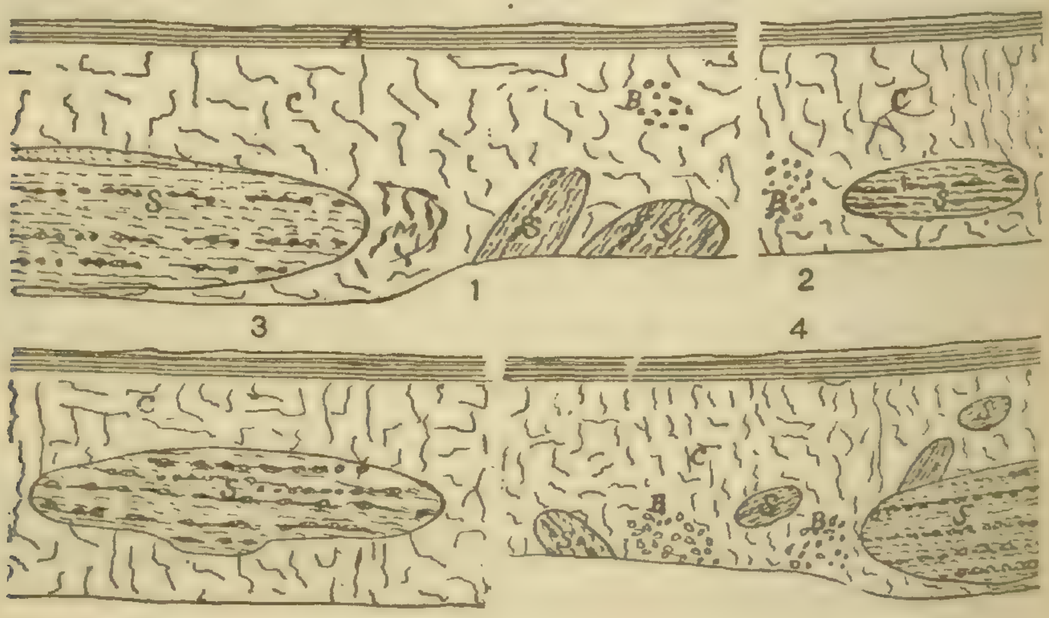
LOCATION.—During the winter of 1883–84 deep excavations were made in the Drift for foundations of additional buildings at the University of Missouri (lat. 38° 57′ N.; long. 92° 20′ W.). The altitude is seven hundred and thirty-six feet above the Gulf of Mexico. The University is near the southern margin of a rolling prairie, bounded by the large valley of the Hurkson Creek, excavated out of Lower Carboniferous limestones to a depth of one hundred and sixty feet.

1. *Geological Associations.*—The large valley dates back to the close of the Lower Carboniferous epoch. It was subsequently more or less occupied by deposits of the Coal-Measures, which have since been removed, except in some embayments and tributary ravines. Whilst these deposits are not found capping the limestone walls of the valley, yet remnants occur farther away, beneath the Drift-mantle, over the elevations of the rolling country, as shown in a well at the Gardens, just east of the University, where the Carboniferous shales have a thickness of

[1] Read before the New York Meeting of the American Association for the Advancement of Science.

thirty-two feet (Professor Tracey). The country to the north is more or less underlaid by coal-basins. The undulations of this region were produced before the deposition of the Drift, as the denudation which removed the Coal-Measures excavated water-courses out of the limestones. To these undulations the Drift conforms, and where cut through by the streams, these flow upon limestone-beds, the higher layers of which abound in chert.

3. *General Character of the Drift.*—At the University Gardens the thickness of the Post-Pliocene deposits reaches twenty-nine feet; at the University, more than twenty-two feet; but in the bed of a stream immediately to the westward it thins out. The upper two to three feet consists of highly-calcareous, clayey soil different from the poorly-calcareous Drift (A, Fig. 1). The Drift consists of a drab, hard, sandy clay, very much cracked and stained with iron,—bright yellow-red; or occasionally with manganese,—bluish-black (Fig. 1). The staining is superficial, and



the mottled appearance has been produced since the deposition of the clay. The clay is rudely stratified, as shown in a wash-out, where a torrent has cut through it (fifteen to twenty feet thick). The lower portion contains fragments of chert from the subjacent rock, and occasional boulders of granite, greenstone, and quartzite, which rarely occur higher in the clay. These boulders seldom reach two feet in diameter, although, eighty to ninety miles to the northward, there is an erratic of about two hundred and twenty-five tons' weight; but the margin of the Drift is not far distant to the southward. Enclosed in the clay

pebbles of crystalline rocks, from one to four inches in diameter, are occasionally found. In a few places there are concretionary nodules of calcareous matter, similar to those of the loess. There are some included layers of compact blue clay. In one section the remains of a tree were found.

4. *The Mechanical Analysis of the Drift, compared with that of the Local Carboniferous Shale.*—[1]

(*a*) The Drift-clay was found to contain

Free rounded sand,	2–0.2 mm. in diameter.....	19.8
" " "	0.2–0.1 " "	9.4
Clayey sand,	0.1–0.05 " "	22.8
Clay,	finer.....	48.0
		100.00

Thus we see that the Drift contains not less than fifty per cent. of free and generally rounded grains of sand, most of which is composed of quartz, with a little that is feldspathic.

(*b*) In the Carboniferous shales there is no distinctly separable sand corresponding to Nos. 1 and 2 of Drift, and none that can be so freely separated as in even No. 3. In short, there are thirty per cent. of sand, at least, in the Drift much coarser and more rounded than that in the local Carboniferous shales, having been transported from the north.

5. *Chemical Analysis of the Drift-Clay* was made by Professor Schweitzer, and found to contain

Silica.....	77.71
Ferric oxide.....	3.08
Manganic oxide.....	0.23
Alumina.....	10.24
Lime.....	0.38
Magnesia.....	0.27
Soda	1.525
Potash	0.575
Phosphoric acid.....	0.02
Carbonic acid.....	0.64
Water.....	5.73
	100.40

6. *Sand-Pockets in the Drift.*—Wherever cuttings are made in the Drift numerous irregular sand-pockets are apt to occur. In most of them, however, the sand is mixed with much clay, but

[1] The separation was in a Shöne apparatus.

they are quickly recognized owing to their brighter color, being more highly stained red-yellow than the clay, as the coloring-matter appears to have been an after-deposit in the more porous earth.

7. *Sand-Boulders.*—Besides the irregular sand-pockets there are occasional well-formed, rounded boulders of sand, distinctly separated from the clay. Some sections, exposed in the foundations and drains, were two hundred feet or more in length, and ten to eighteen feet deep, and cut through many sand-boulders. Some of the boulders were three to four feet long by one to one and one-half feet thick (Fig. 4); one was fifteen feet long and three thick (Fig. 2); another thirty feet by six (Fig. 3); and a right-angled segment eighteen feet in diameter was taken out of another (Figs. 1 and 4), whose thickness was eight feet; but on top of the boulder there was a deposit of fine stratified sand one and one-half feet thick.

8. *Character of the Sand-Boulders.*—The sand is generally coarse (the grains being one to five millimetres in diameter), with parallel layers of pebbles (one to two inches in diameter). It contains a little clay, which, together with the surfaces of the grains, is brightly stained with iron. The boulders usually lie horizontally, but occasionally they are found thrown upon their edges (Figs. 1 and 4), either in the clay, or, rarely, upon another boulder. Where the boulders have been jammed together they are broken or coalesce. The jamming has caused the boulders to be deposited in various positions, bearing no relationship to the direction of the movement of the pack. These masses of sand cannot be mistaken for decomposed sandstone erratics. Owing to the general occurrence of sand-pockets and boulders scattered through the clay, most of the brick walls built upon the clay foundations are liable to crack, as some portion of them rests upon the yielding strata.

9. *Origin of the Sand-Boulders, and the Subaqueous Origin of the Drift.*—From the stratified character of the sand-boulders quietly resting in the clay, and their rounded form, their subaqueous origin is manifest. The rounded form is the result of the waves wearing and dissolving away the angularity of masses of frozen sand. The transportation was effected by coast and floeberg ice, into which the sandy masses were frozen. The smaller masses of sand commingled with the clay were deposited from

the broken ice-carriers crushed in the jams of many an ice-pack. The presence of the sand-boulders forced upon their edges, and often broken, bears evidence of the violent action of the wind and waves upon the ice. These floes were stranded or sunken in waters which derived at least a part of their mud from the north. The boulders were generally rounded before their stranding, for often the clay between them does not show any sand derived from the removal of their angularities; yet broken fragments may be seen (as at B in sections). Owing to their porosity the amount of ice necessary to lift the masses would not be many times their volume (except at jams they are rarely less than several feet, at least, apart), as their buoyancy would be greatly increased by the frozen water within them; and we know that the waters of the Arctic seas freeze to a depth of seven to eight feet during the long winter, and fresh water somewhat deeper. The unbroken boulders could not have been pushed along, nor could they have been formed so as to have been transported upon the back or within a glacier. These deposits were probably made in a shallow arm of the sea (cut off by the Ozark ridge rising a few hundred feet higher); yet the waters may have been either brackish or even fresher,—as in the Gulf of Obi to-day,—owing to the amount of fresh water pouring into it; and not in a glacial lake held back by an ice-dam south of a vast, extensive lake. Besides, we know that the Mississippi Valley has undergone considerable oscillation and warping since the Tertiary period.

10. *In conclusion*, the presence of sand-boulders of northern origin, as well as the erratics, deposited in a somewhat stratified, transported clay, is a demonstration that the Drift of Central Missouri is of subaqueous origin.

NOTE.—Dr. E. Andrews has observed similar sand- and gravel-boulders in the Drift through which the lake tunnel was driven at Chicago. Some of these contained brackish or sea water. Other pockets are found at Homewood (twenty miles southward) and elsewhere. However, the Drift in Northern Illinois differs from that in Missouri, and contains less free sand, and an absence of the abundance of broken sand-boulders seen at the latter place.

EDITORS' TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

WANTED: A definition of a "Philosophical Instrument." "Go to the dictionary," did you say? The definition there found is of no use for present purposes. What is wanted is one which the United States customs officials will respect and be compelled to abide by. These self-sufficient and irresponsible agents of the people have their own views on the subject, and their decisions would be amusing were they not so aggravating. There is an instrument known as a hydrometer. It consists of a glass tube, containing mercury in its lower portion, and a scale. This, the ruling says, is a philosophical instrument, and, as such, pays a duty of thirty-five per cent. The same materials combined in a thermometer constitute no longer a philosophical instrument, but a "manufacture of glass," and, as such, pay a duty of forty-five per cent. So far as we have been able to ascertain, none of the instruments used by the biologist are to be ranked as philosophical instruments. Microscopes and microtomes are "manufactures of metal," as ruled by the Washington wiseacres, in opposition to the opinions of the best scientific men of the country.

This question of duty on importations is a serious one for scientific men. It is all very well to talk of protection to American industry, but this tax on the instruments and books of the student of science actually results in the discouragement of knowledge. If the student desire to import for his own use any book in a foreign language,—a book which has not the slightest chance of being reprinted here,—he is met by that tax of twenty-five per cent.,—a rate which, in many cases, is prohibitory. Can it be wondered that every plan for smuggling the desired books is tried? A more reasonable interpretation of existing laws, or, better, a revision and a reduction of the present duties, would tend generally towards the advancement of American science and the promotion of American honesty.

RECENT LITERATURE.

Wolle's Fresh-Water Algæ of the United States.[1]—In the two substantial volumes of this long-looked-for work we have brought together a great mass of useful knowledge, which will long be a monument to the industry and patience of the author. The labor involved in the preparation of the plates alone, with their multitudes of figures, is something enormous, and, when we remember that this work was all performed by the author himself, one cannot help admiring the spirit which prompted the solitary worker to undertake to give to American students the first manual of the fresh-water Algæ of the country. Hereafter the work will be much easier, and whatever defects or omissions are observed in the present book may be much more easily avoided or corrected in future publications. The book thus marks an important advance in this field of botanical science.

The author, in an introductory chapter of about half a dozen pages, discusses the polymorphism of the Algæ, and its bearing upon the system of classification. Many so-called genera and species are but stages in the life-history of higher forms, as has been made out by the researches of recent investigators, notably by Dr. Anton Hansgirg, of the Royal University of Prague. In summing up, our author says, "It is evident that, sooner or later, the whole system of classification must be changed. The present system is altogether too artificial, separating, as it does, many forms, not only into different genera, but into different families and orders, which are genetically connected. Our present knowledge is too imperfect for a complete arrangement. It is important to understand the life-history of not only a few, but of all, the generic forms."

The system of classification adopted is based upon that of Kirchner ("Krypt. Flora von Schlesien," 1878). The author further remarks, upon the system he adopts, that "many genera are still preserved which have literally no worth, but they serve for reference."

The Algæ treated in the book are arranged under three classes, —viz., Rhodophyceæ, Chlorophyceæ, and Cyanophyceæ. The further subdivisions are as shown in the following condensed tabular arrangement:

Class I.—RHODOPHYCEÆ.

Order I.—*Florideæ*. Families.—1. Lemaneaceæ; 2. Porphyraceæ; 3. Batrachospermaceæ; 4. Hildebrandtiaceæ.

[1] "Fresh-Water Algæ of the United States" (exclusive of the Diatomaceæ); supplemental to Desmids of the United States; with two thousand three hundred illustrations, covering one hundred and fifty-one plates, a few colored, including two additional plates of Desmids. By the Rev. Francis Wolle, member of the American Society of Microscopists. Bethlehem, Pa.: The Comenius Press, 1887. Vol. i., text pp. 364; vol. ii., plates Nos. LIV. to CCX. Price, $10.00.

Class II.—CHLOROPHYCEÆ.

Order II.—*Confervoideæ.* Families.—5. Coleochætaceæ; 6. Œdogoniaceæ; 7. Sphæropleaceæ; 8. Confervaceæ; 9. Pithophoraceæ.
Order III.—*Siphoneæ.* Families.—10. Vaucheriaceæ; 11. Botrydiaceæ.
Order IV.—*Protococcoideæ.* Families.—12. Volvocaceæ; 13. Protococcaceæ; 14. Palmellaceæ; 15. Chytridieæ.
Order V.—*Zygosporeæ.* Families.—16. Conjugatæ; 17. Desmidieæ.

Class III.—CYANOPHYCEÆ.

Order VI.—*Schizosporeæ.*—Families.—18. Nostocaceæ; 19. Chroococcaceæ.

It will be observed that the "families" are groups so named in the German sense, and are really co-ordinate with the Benthamian "orders" of ordinary phanerogamic botany. The six "orders" of the book are, perhaps, equivalent to the "Cohorts" of the higher plants as arranged by Bentham and Hooker. This want of co-ordination may confuse some of our American students whose ideas of botanical orders are derived from the common manuals of the flowering plants, in which "order" and "family" are synonymous.

The descriptions are good, both for genera and species. Analytical arrangements of the species are given in many instances where the genera are large. Measurements are freely resorted to in order to give an idea of the size of filaments, cells, spores, etc. The micromillimetre is used exclusively as the unit of measurement. The plates, while not artistic, are, apparently, quite accurate. Some of them are a little too diagrammatic, as for example, some of the Spirogyræ. The Œdogonia are very well drawn, and are much better than in Cooke's "British Fresh-Water Algæ."

The author deserves the gratitude of American botanists for bringing out this book and placing it within the reach of all, the price being scarcely half of that of the corresponding English work referred to above.—*Charles E. Bessey.*

GENERAL NOTES.

GEOLOGY AND PALÆONTOLOGY.

Scott and Osborn on White River Mammalia.[1]—In this brochure of twenty pages the distinguished Professors Scott and Osborn, of Princeton, have given a preliminary account of their studies of fossils from the classic bad lands of the adjacent regions of Dakota and Nebraska collected by Mr. Samuel Garman for Professor Agassiz's museum in Cambridge. The most important results are as follows: 1. Determination of the loca-

[1] "Preliminary Account of the Fossil Mammals from the White River Formation contained in the Museum of Comparative Zoölogy, Cambridge, Mass." Bulletin of the Museum, vol. xiii. No. 5, August, 1887.

structure of Dinictis, which induces the authors to refer that genus to the Cryptoproctidæ. 2. Determination of the foot-structure of Hoplophoneus, which places the genus in another family,—the Nimravidæ,—in their opinion. 3. The discovery of the pollex in *Oreodon gracilis*, confirming as normal its occurrence in *O. culbertsoni*, previously recorded by Scott. 4. The description of the cranium of Hypisodus. 5. Discovery of the characters of three remarkable new species of Menodus. 6. Discovery of a new and remarkable genus of Hyracodontidæ, named by them Metamynodon, with its species *M. planifrons*. 7. The addition of two new species to Hyracodon.

The discovery of Metamynodon is an important addition to knowledge, and it indicates an advanced point of a line of rhinoceroses with powerful canine teeth in the upper jaw, which first appears in the Eocene, in the genus Amynodon. The authors do not place these genera in the Hyracodontidæ, but propose for them a new family. I, however, think that they cannot be separated from the Hyracodontidæ. Hyracodon exhibits the canine teeth of the upper jaw, but in a reduced condition. In Amynodon, according to Scott, the mastoid bone is exposed on the outer side of the skull.

The true line of ancestry of the rhinoceroses does not come through the Hyracodontidæ, as I showed in 1881.[1] I then regarded the genus Cænopus (Cope) as the ancestral form of the family,[2] as I had already observed the Lophiodontid character in the skeleton of the species then known to me[3] (*C. mitis* Cope and *C. occidentalis* Leidy). Further observations to the same effect are made by Professors Scott and Osborn in the present paper. I have also noticed that the superior premolar teeth in Cænopus do not differ essentially from those of the Lophiodontidæ, and are totally different from those typical of Rhinocerontidæ and Hyracodontidæ.

The transverse crests are united at their inner extremities, as in Lophiodontidæ, and do not continue distinct to the end, as in the two families named, and as is especially shown to be the case in Amynodon and Metamynodon by Scott and Osborn. In some species of true rhinoceroses the transverse crests become confluent on wearing, in consequence of the development of angles or "crochets," but the crests are essentially distinct. In Aceratherium (type, *A. incisivum*) the superior premolars are of the true rhinoceros type. In the *Rhinoceros schleiermacheri* they are, on the other hand, constructed, as in Cænopus, on the Lophiodontid pattern. This species must be, therefore, separated from Ceratorhinus, where I have placed it. Brandt has

[1] Proceedings Amer. Philosophic. Soc., 1881, p. 380: "On the Systematic Arrangement of the order Periosodactyla."
[2] Loc. cit., p. 394.
[3] Bulletin U. S. Geolog. Survey Terrs., 1879, v. p. 235.

already proposed for it the name Dihoplus.[1] It differs from Cænopus in the presence of a dermal frontal horn, according to Brandt. I therefore propose as new the family Cænopidæ, which is distinguished from the Lophiodontidæ by the absence of superior canine teeth. It embraces two genera,—viz., Cænopus, hornless; and Dihoplus, horned.

In Cænopus one of the premolars—the second—has the rhinocerotic structure, in the two species known. In distinguishing this genus I rely on the structure of the superior premolars rather than on that of the anterior foot. I am not able to substantiate my statement that there are but three digits in the manus of *C. mitis*, and Scott finds four in that of *C. occidentalis*. —*E. D. Cope.*

Marsh on New Fossil Mammalia.[2]—About three weeks after the reception of the paper of Professors Scott and Osborn, the number of the journal which contains this essay was received (October 1). We mention this fact, since the two papers partly cover the same ground, so far as relates to the perissodactyle family of the Menodontidæ. Professor Marsh gives some excellent wood-cuts taken from specimens derived from various parts of the West, to which he gives names, referring them to eight species. The first species is referred to the genus Bison, and it may be recognized by the cut, but not by the description. The second is the well-known and abundant *Aphelops fossiger* Cope, which receives the new name Aceratherium acutum. The remaining species are Menodontidæ, which Professor Marsh calls Brontotheriidæ, although Brontotherium has been shown several times to be undistinguishable from Menodus. Two species of the *Symborodon helocerus* group are referred to a new genus under the name of Brontops. This genus, if valid, will stand between Menodus and Symborodon. *Symborodon trigonoceras* Cope next appears under the name "Menops varians." The generic character as given does not differ from that of "Brontops," and the species is undescribed. The *Menodus platyceras* S. & O. next appears as "Titanops curtus" Marsh; no description is given for either genus or species. A second species is referred to the same genus, and a few of the characters are barely referred to. Finally, another new genus and species are named, but most insufficiently described, and no figure is given.

The publication of pictorial scientific papers is praiseworthy, but something more than pictures is necessary to make a paper scientific. And if one does not examine the easily-accessible

[1] Brandt, "Tentamen Synopsis Rhinocerotidum." Mem. Acad. Imp. Sciences St. Petersburg, 1879, vol. xxvi. p. 48.

[2] "Notice of New Fossil Mammals;" by O. C. Marsh. American Journal Science and Arts, 1877, October, p. 323.

types of the work of others, he is very apt to make publications which savor strongly of plagiarism. In any case, however, while a man may do what he pleases with his own money and take the consequences, it is a public scandal that a scientific bureau of the United States government should permit its money to be used in the way indicated in this paper and in others by the same author. —*E. D. Cope.*

Scott on Creodonta.[1]—In this quarto brochure we have descriptions of six species, of which three are new, and of which three are illustrated by plates. A number of important additions to our knowledge of the osteology of the Creodonta are made. The most remarkable specimen described is a nearly complete skeleton of *Mesonyx obtusidens* Cope. From this Professor Scott has made a restoration, which gives an idea of the proportions of this curious animal. It was about the size of the black bear, and had a much less robust skeleton than that carnivore. The brain-case is very small, and the sagittal crest very high. The specimen proves that the genus Pachyæna differs from it in the presence of one more premolar or molar teeth, and of the entepicondylar foramen of the humerus, as well as in the inequality in the length of the limbs. A large new Mesonyx is described under the name of *M. uintaensis*. It is of much interest as coming from the Diplacodon beds, and it probably represents the last of its family.

The genus Didymictis is shown to possess the embracing zygapophyses of the lumbar vertebræ observed in Creodonta generally, thus confirming the reference to that group. The scaphoid and lunar bones of the carpus are shown to be distinct, confirming the reference of this genus to the same suborder. The characters of the foot and brain of Hyænodon are pointed out for the first time. The genus is shown to be five-toed, and plantigrade, and to possess an *os centrale carpi*. The brain is slightly convoluted, and of elongate form. Professor Scott believes the brain-cast figured by Gervais as that of this genus belongs to some other type. He thinks it probable that the scaphoid and lunar bones are united in some of the European species, while in others it is distinct, as in the American species. To the latter he believes De Blainville's name Taxotherium to be applicable.

Professor Scott closes by defining the suborder Creodonta, and by a discussion of its affinities. He believes the group to be distinct from both the Insectivora and the Carnivora.—*E. D. Cope.*

[1] "On some New and Little-Known Creodonts," by W. B. Scott. Extracted from the Journal of the Academy of Natural Sciences of Philadelphia, August 10, 1887.

BOTANY.[1]

The Eastward Extension of Pinus ponderosa Douglas var. scopulorum.—This pine, according to Professor Sargent, extends throughout the Rocky Mountain region eastward to "the Black Hills of Dakota, Colorado, and Western Texas ("The Woods of the United States," p. 119). The same statement is made in vol. ix. of the "Reports of the Tenth Census," p. 193. Coulter, in the "Manual of Rocky Mountain Botany," says that it "is found throughout the Rocky Mountains." In one of the maps (No. 12) accompanying Professor Sargent's ninth volume of the census reports alluded to above, the range of this pine is indicated by colors. Its eastern border may be described as a line beginning near the northwestern corner of Montana and running by a somewhat sinuous course to the southeast corner of the Territory, where it swings out into Dakota so as to include the Black Hills; it immediately passes back westward and northwestward into Wyoming to the Rocky Mountains, near the front range of which it then passes southward to Texas, following pretty closely the 105th meridian. This pine, therefore, according to this map, and all the descriptions referred to, reaches its most eastern station in the Black Hills of Dakota, at about 103° of west longitude.

In a recent botanical excursion into the northern portion of Nebraska I found this pine at a number of stations fully three degrees farther to the eastward of the Black Hills. It is abundant along the bluffs of the Niobrara River from near the 100th meridian to near the 102d, and probably much farther westward. On the buttes which abound in Northwestern Nebraska, along the head-waters of the White River, this pine is so abundant as to give them, at a distance of a few miles, a black appearance. In this the buttes of this part of Nebraska resemble the Black Hills. Whether these bodies of pine are connected with the Wyoming forests I have not been able to determine with certainty, not having had time to follow the river farther; but from various apparently trustworthy accounts I am led to believe that there is such connection. Whether these Nebraska pine-forests are connected with those of the Black Hills I have not determined, but think they are not.

Upon the bluffs bordering the Great Cañon, in which flows the Wasahancha Creek, commonly called Long Pine Creek, pines abound. This cañon extends in a north and south direction, on the south side of the Niobrara River, and is about fifteen miles east of the 100th meridian. Inquiries failed to indicate the existence of the pines eastward of this cañon, and I think that we may note this station as the most eastern point reached by this

[1] Edited by Prof. CHARLES E. BESSEY, Lincoln, Nebraska.

species. It is interesting to note that the Indian name of the creek, Wasahancha, is said to mean "where the pines extend far out," as if the Indians had also noted the remarkable eastward extension of the Rocky Mountain pine.—*Charles E. Bessey.*

The Westward Extension of the Black Walnut.—The westward limit of the black walnut (*Juglans nigra* L.) is given by Sargent as Eastern Nebraska and Eastern Kansas ("Woods of the United States," p. 76, and vol. ix. "Reports of the Tenth Census," p. 131). Upon map No. 5, belonging to the census report, the line marking the western boundary of the black walnut area enters Iowa from the north about twenty miles east of the northwestern corner of the State; it crosses the Missouri River into Nebraska a short distance below Sioux City, passes through Lincoln, and enters Kansas on the 97th meridian, where it then bends to the westward, reaching, in Central Kansas, the meridian of 98½° of west longitude, as it does also in Middle Texas.

I wish now to place on record the occurrence of the black walnut upon the Niobrara River and its tributaries in Northern Nebraska as far west as the 100th meridian. Upon the Wasahancha Creek ("Long Pine") it grows abundantly, in company with the Rocky Mountain pine (*Pinus ponderosa*, var. *scopulorum*). I doubt whether these two trees can be found in company anywhere else upon the continent. Each has stretched out a long arm from its forest area, and the two trees have thus come together.

At the station mentioned I saw walnut-trees between two and three feet in diameter, and am informed that, several years ago, a considerable quantity of walnut lumber was manufactured from the trees in the cañon.—*Charles E. Bessey.*

The Iron-Wood Tree in the Black Hills.—Although limited westwardly to "Eastern Iowa, Southeastern Missouri, and Arkansas, to Eastern Kansas, the Indian Territory, and Eastern Texas," by Sargent ("Woods of the United States," p. 95), I recently observed the iron-wood (*Ostrya virginica*), in considerable abundance, upon the head-waters of Rapid Creek, in the Black Hills of Dakota. The trees were not large, but were loaded with their hop-like fruits. It occurs also in Northern Nebraska, upon the Niobrara River and its tributaries, and in the eastern counties along the Missouri River.—*Charles E. Bessey.*

Still Another Tumble-Weed.—The list of plants having the habit of rounding up their stems and branches so as to form a nearly spherical plant body, which at the end of the season breaks away at the root, thus forming a "tumble-weed," must be increased by adding the winged pig-weed (*Cycloloma platy-*

phyllum). This plant grows sparingly about Lincoln, Neb., but along the Platte River it is very abundant upon the sandy soil near the river, and upon land which has, after ploughing, been allowed to lie idle. About Long Pine and Valentine it almost entirely replaces *Amarantus albus*, the common tumble-weed, but at Chadron the latter occurs almost to the exclusion of the winged pig-weed. At a little distance the two plants look exactly alike excepting in color. The winged pig-weed is of a light yellowish-green color, while the other is dark green.—*Charles E. Bessey.*

Botany in the A. A. A. S.—An examination of the daily programme issued by the Association shows that there were seventeen botanical papers presented for reading in Section F. The zoological papers numbered twenty-two. Taking the time estimated by each author as necessary for the reading his paper, one finds that the botanical papers averaged thirteen minutes in length, and the zoological ones seventeen. This would indicate that there is still some work left for the Botanical Club. It should weed out more of the short notes and hastily-prepared papers. Of course, it is not just to say that short papers are necessarily of less value than long ones, or that papers are valuable in proportion to the time they consume in the reading; nevertheless, it remains true that many short papers are so because of the fact that the author did not take time to fully prepare himself.

The Botanical Club appears to have been very successful this year, one hundred and forty members having recorded their names at this meeting, against one hundred and twenty-one at Buffalo, and eighty-five at Ann Arbor. One of those present writes that "every one noticed the prominence which botany has taken in the Association. Yellow badges were numerous. The single hour—a short hour—for a few of the days was too short for the work of the Club. More time could have been profitably given to informal discussions and short notes. The botanical papers of the Association, and of the Club, were numerous and of good quality. The receptions and excursions were well planned, well patronized, and gave an excellent chance for acquaintance and a comparison of methods."

Botanical News.—There have lately appeared English translations of two valuable German botanical works,—viz., "The Comparative Morphology and Biology of the Fungi, Mycetozoa and Bacteria," by De Bary, and the "Lectures on the Physiology of Plants," by Sachs. Both books are brought out by the Clarendon Press of Oxford.——"The Task of American Botanists" is discussed by Dr. Farlow in a paper in the July *Popular Science Monthly*, which he previously read before the

American Society of Naturalists. The author rightly urges American botanists to work along lines suggested by their surroundings. "In the remoter districts the absorbing work for some time to come must be the collecting of specimens and the accumulation of field-notes." In the older parts of the country the author urges histological study and "the study of the life histories of different plants, more especially cryptogams." The paper deserves to be widely read.——Dr. Farlow's address as vice-president of Section F of the American Association for the Advancement of Science, on "Vegetable Parasites and Evolution," contains much suggestive matter. For the higher parasites,—*e.g.*, the species of Cuscuta,—"they may be regarded as degenerate forms of other phanerogams." As to lichens, the author sees no reason "why we may not consider the gonidia to be what they appear to be,—viz., algæ; and the hyphæ, fungi parasitic on the gonidia." As to the origin of the fungi,—*i.e.*, the group,—the view "which seems to be more in accord with existing facts than any other" is that they have arisen "not from any one primitive group of algæ, but from different groups of algæ at different periods in the progress from below upward." Incidentally, the author gives his reasons for believing that the species of fungi are more numerous than those of the phanerogams.——Late numbers of the *Journal of the Linnean Society* contain Baker's further contributions to the "Flora of Madagascar;" Bateson and Darwin's "Effect of Stimulation on Turgescent Vegetable Tissues;" King's "Observations on the Genus Ficus, with special reference to the Indo-Malayan and Chinese Species;" Massee's "Disease of Colocasia in Jamaica," with an introductory note by Morris; and Bennett's paper on the "Affinities and Classification of Algæ."——In the August *Journal of Botany* Baker continues his "Synopsis of the Tillandsieæ," and Jackson his "Remarks on the Nomenclature of the Eighth Edition of the 'London Catalogue.'" A short paper on the "History of Botany in Japan," accompanied by a portrait of Ito Keisuke, is instructive and entertaining.——An important paper by Voglino, on the Agaricini, appeared in the July *Nuovo Giornale Botanico Italiano*. Microscopical measurements and descriptions of the spores, basidia, and sterigmata are given. ——The August *Journal of Mycology* completes the enumeration and description of the "Septorias of North America."—— An important change in the addresses of two of the editors of the *Botanical Gazette* is announced in the August number. Dr. Barnes, having accepted the chair of Botany in the University of Wisconsin, must be addressed hereafter at Madison, Wis Dr. Arthur succeeds Dr. Barnes in the chair of Botany in Purdue University, and must be addressed hereafter at Lafayette, Ind. ——*Bulletin No. 4*, from the Botanical Division of the Department of Agriculture at Washington, contains a list of the "De-

siderata of the Herbarium for North America north of Mexico,' including Ranunculaceæ to Rosaceæ. We trust that botanists will very generally respond to the appeal for specimens.

ENTOMOLOGY.[1]

On the Homologies of the Wing-Veins of Insects.—Using the conclusions of Adolph[2] as a starting-point, Redtenbacher has made a very elaborate investigation into the homologies of the veins of the wings of insects; and, although his conclusions may not be generally accepted, they will be of interest to all systematic entomologists. The work treats of each of the orders of winged insects, and is illustrated by twelve plates, upon which are one hundred and sixty figures of the wings of insects. We have space for only a few extracts from the introductory portions of the memoir.

The geologically-older insects have a richer venation than the later-appearing forms. It is evident from this that the oldest insect-forms were provided, so to speak, with a superfluity of veins, and that in the course of development all that were superfluous have been lost. In this way simpler wing-venation has been brought about.

Various views are held regarding the origin of the wings. While some believe the wings to be sac-like prolongations of the body-wall, Fritz Müller calls them lateral continuations of the dorsal plates. Oken, Graber, Gegenbauer, Landois, Palmén see in them metamorphosed tracheal gills. Weissmann is of the opinion that the wing-nuclei form themselves out of the peritoneal sheath of tracheal trunks, and only secondarily cause a prolongation of the body-wall.

That the wings of insects are equivalent to the tracheal gills of the *Ephemerid* larva can hardly admit of a doubt. Whether they have arisen out of tracheal gills is still questionable, for it is not beyond the range of possibility that the opposite is the case,—viz., that wings, through metamorphosis, become tracheal gills. It is not only possible, but even probable, that the wings of insects were originally not active, but merely passive, organs of motion, serving, like the pappus of the Compositæ, for example, for the floating and spreading of the progeny to a distance.

The essential nature of a rudimentary wing is a hollow sac which is filled with blood-liquid, contains nerves and tracheal filaments, and whose two plates do not grow together until the

[1] This department is edited by Prof. J. H. Comstock, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

[2] Ueber Insectenflügel, von Dr. G. Ernst Adolph, Nova Acta der ksl. Leop.-Carol. Deutschen Akademie der Naturforscher. Band xli. Pars II., Nr. 3. Halle, 1879.

[3] Vergleichende Studien über das Flugelgeäder der Insecten, von Josef Redtenbacher, Annalen des k. k. Naturhistorischen Hofmuseums. Band i. pp. 155–230. Wien, 1886.

last moult. According to Adolph, these tracheal filaments represent the foundation of the vein-system,—to wit, of the concave veins; since the course of these, in the rudimentary wing, coincides completely with the net-work of concave veins in the developed wing. Only later is every trachea shut in and closed by chitine-mass, and thereby transformed into a rib. At the same time, according to Adolph, the tracheæ force the two wing-plates apart and beget a *thinning* of the wing-skin, which shows itself, among other ways, by the fact that the wings, in case of pressure or draught, regularly tear along the concave veins. Between these primary or concave veins appear later *thickenings* of the wing-skin, in the form of chitine lines, with which, finally, tracheæ and blood-vessels associate themselves, and which form secondary, or convex, veins. The two sorts of veins stand, accordingly, in direct opposition to each other; since the former is caused by *thinning* and the latter by *thickening* of the wing-skin; and since in the former the trachea, in the latter the chitine-band, represents the primary formation.

A circumstance not brought out by Adolph is that the two forms of veins occupy different superficial layers, since the primary run on a deeper level than the secondary; whence the former may be designated as concave or valley veins, the latter as convex or mountain veins. In the case of a regular succession of veins the transverse section of the wings must accordingly form a zigzag or wavy line, which, even at the first glance, suggests the thought that a folding must be the cause of this appearance.

If, now, one proceeds on the assumption that the wing-plates grow faster than the enclosing wing-sheath, which offers them only a narrow space, it is easily conceivable that the wing must lay itself in tolerably regular folds. And this is the more natural since the primary veins are formed by the thinning of the wing-skin, and, in consequence, most readily suffer bending and notching exactly upon these lines, while the intermediate fields at first appear only slightly convex, but by continued lateral pressure become ever more firmly compressed.

The primitive insect-wing is fan-like,—*i.e.*, formed out of regularly-alternating concave and convex veins. Such a fan, however, could be capable of complicated motions of flight only in case its convex veins, or at least a majority of them, were furnished with separate muscles. Since this, for evident reasons, is inconceivable, there remain only two ways out of the dilemma: either only one part of the wing is moved and the other passively drawn along, or there must take place such a uniting and grouping of the wing-veins that a smaller number of muscles suffice to move the wings correspondingly. In the first case an active flight is impossible. The wing works rather, in climbing, like a kite; in descending, like a parachute. This can be observed in those forms which still show approximately the fan type of wings

(the Saltatorial Orthoptera and Ephemeridæ). In the great mass of insects the second case is true; the veins of the original fan unite themselves into a few groups, which can be moved either independently or together, and yet require only a small number of muscles. The wing is divided, as a result, into a number of parts, which lie one behind another, and are united with each other by a sort of hinge. The latter can consist only of concave veins or folds, as these represent thinnings of the wing-plates.

In case of many insects (Lepidoptera and Diptera) it is a matter of some difficulty to determine the character of a vein. Concave veins often appear convex (subcosta of butterflies), while, on the other hand, convex veins take on the character of concave veins. In cases where concave and convex veins come into close relation, as with the flies, the true character of a vein is often scarcely recognizable. In general, concave veins run deeply, protrude more strongly on the under than on the upper side, cross-veins are frequently interrupted by them, and at the edge of the wing they often end at a re-entering angle, or, at least, into a baying-in of the margin. The convex veins, on the contrary, are, as a rule, swollen; they never interrupt cross-veins, and only exceptionally end in a re-entering angle, but, on the contrary, often cause at the end bayings-out of the wing-margin.

Redtenbacher defines five fields in the fully-developed wing of an insect. These are (1) the costal field, with the costa; (2) the radial field, with the radius and its numerous sectors; (3) the field of the fifth vein, or the medial field; (4) the cubital field, with the cubitus; and (5) the anal field. He also proposes a uniform nomenclature for the venation in all of the orders. The systems of convex veins running in the several fields are designated by the successive odd Roman figures,—*i.e.*, those of the costal field, by I.; of the radial field, by III.; of the medial field, by V.; of the cubital field, by VII.; and of the anal field, by IX., XI., XIII., etc. The concave line (veins or folds) running between the fine convex trunks he designates by the even Roman numerals,—thus, the concave line between veins I. and III. is indicated by II., and that between III. and V. by IV., etc. The several branches of a lengthwise vein are designated by indices appended to the Roman numerals. Arabic odd numerals are used in case of the convex veins, and Arabic even numerals for the concave,—*i.e.*, the sectors of the radius are designated as III_1, III_3, III_5. If, as is frequently the case, concave folds or veins appear between the branches of a convex trunk, they are designated by the Roman numerals of the convex system in question, with an even Arabic numeral added as an index,—thus, a concave vein between III_3 and III_5 is indicated as III_4.

Redtenbacher gives a table showing the equivalents in his system of the terms employed in the various systems in common use.—*J. H. C.*

The Genera of North American Phalangiinæ.—In working over the rich collections of harvest-men belonging to the Illinois State Laboratory of Natural History, in connection with recent European literature, I find that very few of the species described by Wood,[1] under the old genus *Phalangium*, belong to that genus as now restricted by the best European authorities. I have before me specimens of eight of the species treated by Wood (my determinations of all but two of them having been verified, through the kindness of Mr. Charles W. Woodworth, by comparison with the types in the Museum of Comparative Zoology), and I find that *P. dorsatum*, *vittatum*, *nigropalpi*, and *verrucosum*, all belong to the genus *Liobunum* of C. Koch, as defined by Simon.[2] I have also provisionally referred *P. formosum* and *P. calcar* to this genus, though, on account of the projecting inner angle of the palpal patella in the former and the spur-like process on the outer ventro-lateral surface of the femur of the palpus in the latter, they do not appear to strictly belong to it. *P. cinereum* falls into the restricted genus *Phalangium*, and *P. pictum* goes to *Oligolophus*. I suspect that *P. bicolor* and *P. ventricosum* also belong to *Liobunum*.

In this connection, I desire to call the attention of collectors to a simple method by which the genital organs of the Phalangiinæ may be exposed for study,—a fact which aids considerably in their determination, as these organs, especially in the male, frequently have specific peculiarities. If the caudal portion of the abdomen be compressed between the thumb and finger, the genital organs will be pushed out of the genital opening between the coxæ, and, if the specimen be dropped immediately into alcohol, will generally remain exposed. This method of protruding the genital organs was first described by Latreille in 1796, but does not seem to have been known to many later writers. It is very much preferable to the method of dissection described by Wood. I incline to believe that by its use good distinguishing characters can be obtained from the ovipositor, which will aid in separating the females of certain species that closely resemble each other.—*Clarence M. Weed, Illinois State Lab. Nat. Hist., Champaign*, 18th August, 1887.

ZOOLOGY.

Key to the Recent Families of Sponges.—The following "key" is taken from Dr. R. von Lendenfeld's recent paper (*Proc. Zool. Soc. London*, 1886, pp. 558–662, 1887) on the "Systematic Position and Classification of Sponges":

0. { Skeleton calcareous 1
   { No calcareous skeleton 6
1. { Entoderm consists exclusively of collar-cells 2
   { Entoderm consists of collar- and pavement-cells 3

[1] Commun. Essex Inst., vol. vi. pp. 10–40. [2] Arach. de France, vol. vi. p. 172.

2. Mesoderm thin, gastral cavity irregular..... *Asconidæ.*
   Mesoderm thin, radial cylindrical chambers..... *Homodermidæ.*
   Mesoderm thick, irregular chambers..... *Leucopsidæ.*
3. With cylindrical chambers..... 4
   With spherical chambers..... 5
4. Chambers radial, opening directly into gastral cavity..... *Syconidæ.*
   Chambers opening into exhalent canals which lead into the gastral cavity..... *Sycilleibidæ.*
5. Exhalents lead into oscular tubes..... *Leuconidæ.*
   Exhalents open direct on one side of the lamellar sponge; inhalent pores on the other side exclusively..... *Teichonidæ.*
6. With hexact spicules and thimble-shaped chambers..... 7
   Without hexact spicules; with spherical or sac-shaped chambers..... 10
7. The spicules remain isolated or partly coalesce, afterwards irregularly.... 8
   The supporting spicules early coalesce in a regular dictyonid manner..... 12
8. Hexaster in the interior..... 10
   No hexasters, but amphidiscs..... 11
9. Hypodermalia hexact, sword-shaped, with centripetal radial ray the longest; no pinnulæ..... *Euplectellidæ.*
   Pinnulæ in the gastral and dermal surfaces..... *Asconematidæ.*
   Dermalia without centripetal ray; no pinnulæ..... *Rossellidæ.*
10. With numerous pinnulæ..... *Hyalonematidæ.*
11. With uncinates..... 13
    Without uncinates..... 15
12. With radially situated clavulæ..... *Farreidæ.*
    With radially situated scopulæ..... 14
13. Branched and anastomosing tubes; the skeleton-net forming several layers..... *Euretidæ.*
    Branching tubular or calyculate, honeycombed; cavities traversed by reticular membrane..... *Melittionidæ.*
    Calyculate or expanded, traversed transversely by funnel-shaped canals opening alternately on one or other surface..... *Coscinoporidæ.*
    Canals irregular, traversing the dense dictyonal skeleton obliquely or longitudinally..... *Tetradictyidæ.*
14. Meandrically winding tubes..... *Meandrospongiidæ.*
15. With cartilaginous ground-substance and spherical chambers. Spicules polyact, tetract, lithistid, tylostylote, or stylote; never cemented with spongin. Askeletous forms with spherical chambers..... 17
    With soft ground-substance, spherical or sac-shaped chambers. Spicules monaxon, never tylostylote, cemented with spongin. Or skeleton composed of horny fibre without proper spicules. Askeletous forms with sac-shaped chambers..... 30
16. With lithistid irregular tetraxon spicules..... 18
    With tetraxon spicules of irregular shape; askeletous forms with large chambers, which have large outlets..... 27
    With monaxon tylostylote spicules..... 29
    Without supporting spicules; flesh-spicules, when present, polyact; with small chambers which have narrow outlets..... 29
17. Spicules quite irregular..... *Rhizomorinidæ.*
    Spicules rod-shaped, with terminal tufts of branches..... *Anomocladinidæ.*
    Spicules tetractin, with terminal branches..... *Tetracladinidæ.* 20
18. Spicules chiefly tetracts, with equal rays and candelabra..... 23
    Large tetract spicules, with three equal rays lying tangentially in or beyond the surface, and one differentiated radial ray..... 21
19. With small inconspicuous ciliated chambers with small outlets..... 22
    With large conspicuous ciliated chambers with wide outlets..... *Corticidæ.*
20. With candelabra..... *Pachastrellidæ.*
    With simple tetracts..... *Plakinidæ.*
21. With scattered tetracts, triacts, diacts..... *Oscarellidæ.*
    Without spicules..... *Oscarellidæ.*
22. Tetracts with differentiated large centripetal ray and large tangential rays numerous..... 24
    Tetracts with differentiated large centripetal ray rare, with small tangential rays..... 26

23.	With spherasters	*Geodidæ.*
	Without spherasters	25
24.	Flesh-spicules euaster and oxyaster	*Stellettidæ.*
	Flesh-spicules spirastrella	*Theneidæ.*
	Flesh-spicules spirula and sigmata	*Tetillidæ.*
25.	Without flesh-spicules	*Tethyopsyllidæ.*
26.	The widened distal ends of the radial spicule-bundles divide the regular subdermal cavities into ectochonæ or vestibules at the entrance of the inhalent canals	*Tethyidæ.*
	Between the distal ends of the radial spicule-bundles ecto- and entochonæ are found	*Sollasellidæ.*
	The inhalent pores lead direct into the inhalent canals	28
27.	With spirastrellid flesh-spicules	*Spirastrellidæ.*
	With sigmate flesh-spicules	*Suberamatidæ.*
	Without flesh spicules	*Suberitidæ.*
28.	With polyact flesh spicules	*Chondrillidæ.*
	Without flesh-spicules	*Chondrosidæ.*
29.	With proper spicules in the supporting skeleton	31
	Without proper spicules in the supporting skeleton	35
30.	With uniformly distributed skeleton reticulation and not very large subdermal cavities	32
	The skeleton consists of a dense axial reticulation and isolated fibres extending from this to the surface. Beneath these very extensive subdermal cavities are situated	34
31.	With gemmulæ; living in fresh water	*Spongillidæ.*
	Without gemmulæ	33
32.	Without flesh-spicules; fibres of the supporting skeleton not spined	*Homorhaphidæ.*
	Flesh-spicules sigmata or spiral, no chelæ	*Heterorhaphidæ.*
	Flesh-spicules chelæ; when absent fibres of supporting skeleton spined	*Desmacidonidæ.*
33.	No chelæ	*Axinellidæ.*
34.	With small spherical chambers and opaque ground-substance	36
	With large sac-shaped chambers and transparent ground-substance	39
35.	Without filaments in the ground-substance	37
	With filaments in the ground-substance	38
36.	Skeletal fibres with thin axial canal	*Spongidæ.*
	Skeletal fibres tubular, with thick pith	*Aplysinidæ.*
37.	Skeletal fibre with thin axial canal	*Hircinidæ.*
38.	Skeletal fibres with thin axial canal; reticulate	*Spongelidæ.*
	Skeletal fibres tubular, with thick pith; dendritic	*Aplysillidæ.*
	No skeleton	*Halisarcidæ.*

The reader is referred to this journal (September, 1887) for Dr. von Lendenfeld's grouping of the families embraced in the foregoing "key" into orders and larger groups. The following list will be found to embrace the most important technical terms introduced by the author or adopted from previous writers:

Astylote, without style-shaped spicules.

Amphidisc, a rod with an umbrella-shaped disk at each end.

Chelæ, anchor-shaped spicules.

Ciaculæ, rods pointed at one end and bearing a knob or disk at the other.

Dermalia, dermal spicules.

Diactina, a member of the tetraxonia group of spicules, with three rays.

Dictyonid, the main hexact spicules coalesce, to begin with, in

a very regular manner so as to form a continuous skeleton, as in the suborder Dictyonina.

Euaster, a stellate spicule with stout pointed conic spicules radiating from one point. Occurs only in flesh-spicules.

Gemmulæ. The winter buds or statoblasts of fresh-water sponges.

Hexaster, a star-shaped spicule with six generally equal rays, belonging to the triaxonian group.

Hypodermalia. Dermalia with imbedded radial ray only.

Lithistid, as in the group Lithistida, which has the spicules tetraxon and often branched.

Monaxonia, with one straight or curved axis, rod-shaped, sometimes with lamellar outgrowths.

Oxyaster, a stellate spicule with long, slender pointed rays radiating from one point. Occurs only among flesh-spicules.

Pinnula, a triaxonian star with five or six rays, one of which is highly developed and branched or covered with disks or scales. The opposite ray is smooth or absent; the other four equal (tangential).

Polyact, without definite axes and with numerous rays.

Scopulæ, fork- or broom-shaped spicules consisting of a long shaft traversed by an axial rod, to the distal end of which some slender anaxial rods are attached.

Sigmata, S-shaped irregularly-curved flesh-spicules.

Spheraster, a ball of spicules radiating from a common centre.

Spirastrella, a spicule the numerous rays of which arise from a stout spiral base.

Spirula, a spiral spicule without spines.

Stylus, a rod-shaped spicule pointed at one end and rounded at the other, but not knobbed.

Tetraxona, with four axes radiating from one point. The ends of the spicules lie in the corners of a square pyramid and their derivatives.

Tetractina, a tetraxonian spicule with four rays.

Triaxonia, spicules with three axes and six rays and their derivatives.

Triactina, a tetraxonian spicule with three rays.

Uncinata, a rod with recurved hooks throughout its entire length.

Occurrence of Stizostedium vitreum in the Basin of the Connecticut.—In March, 1887, a small specimen of the above-named species was brought to the Museum of Wesleyan University, having been caught in Little River, a tributary of the Connecticut, in the town of Cromwell, Conn. The specimen was about eleven and one-half inches in length. The find appeared so extraordinary that the fact was communicated to Professor Goode, of Washington. Subsequently the specimen was

forwarded to him, and the identification of the species was confirmed by him. The remarkable interest of the find appears when it is considered that no species of Stizostedium is known in any of the rivers of the Atlantic coast between the St. Lawrence and the Susquehanna. The question has been raised whether the species could have been introduced accidentally in stocking the Connecticut with shad and salmon. This does not seem probable. I am informed by Hon. R. G. Pike, one of the Fish Commissioners of Connecticut, that all the eggs of shad used in stocking the Connecticut have been derived from localities within the Connecticut basin itself. Salmon have been introduced into the Connecticut from the St. Lawrence basin, but no such importation has taken place since 1879. As no instance is known of the capture of Stizostedium in the Connecticut during the intervening years, it is not likely that it was introduced with the salmon. It appears likely that the eggs were carried across from the waters of the St. Lawrence basin to those of the Connecticut basin by becoming attached to the feet of birds. Any one who will observe on the map how close together the tributaries of the two streams come, at a number of localities in Northern Vermont and Southern Canada, will recognize how easily the transfer might be accomplished. It is among the possibilities that a Stizostedium caught by some sportsman in a tributary of the St. Lawrence might have been thrown, still living, into a tributary of the Connecticut.—*William North Rice, Wesleyan University, Middletown, Conn.*

Birds Roosting in a Town.—For several weeks past the large maples and lindens of the centrally-situated court-house square in Media have been literally alive with the birds that come there to roost each night. Just before dusk a continual stream of blackbirds, robins, and English sparrows may be seen coming from every quarter, and all bound for this little grove in the most central portion of the town. By the time daylight fails many thousands (I speak advisedly) of individuals belonging to these different species have assembled, and the commotion among the leaves during the process of settling for the night is something wonderful. If one hits a tree with a stone there is a noise of wings amounting to a perfect roar. Nor is this coming in of birds from the surrounding country for a night's lodging any new phenomenon in Media. Last year a heavy rain one night drowned about one hundred and fifty of them, and the boys the next morning gathered them with much glee. But is this not a remarkable thing, that these birds should seek a roosting-place in the heart of a town, and nightly pass over and reject hundreds of acres of trees where there would appear to be much less probability of their being disturbed? I have heard no satisfactory explanation of the matter, although much has been said con-

cerning it by one and another. Can some of your bird-loving readers tell us the why and the wherefore? For, I doubt not, similar cases are not wanting, there being no new thing under the sun.

I am, etc.,

MEDIA, PENN., September 7, 1887. T. C. PALMER.

The Relation of the Dorsal Commissures of the Brain to the Formation of the Encephalic Vesicles.[1]—There are a number of features which are so universally characteristic of the vertebrate brain at its earliest stage of embryonic development that we are justified in considering them as primitive characters of the brain of the vertebrate stem. These are: 1. The constriction of the neural tube into four vesicles, which represent the prosencephalon, the thalamencephalon, the mesencephalon, and metencephalon.[2] 2. The formation of minor folds (*neuromeres*) at the sides of the metencephalon, corresponding to the roots of the *vagus* and other cranial nerves. 3. The three outgrowths from the thalamencephalon forming the paired and median eyes. 4. The diverticulum from the floor of the thalamencephalon forming the hypophysis. The meaning of the second and third of these developmental features is now understood, but, to my knowledge, no adequate explanation has yet been offered either for hypophysis or for the encephalic vesicles. For the latter I offer the following hypothesis: *that the constriction of the brain-roof which gives rise to the four vesicles is for the accommodation of three nerve-fibre tracts decussating dorsally, viz., the superior and posterior commissures and the cerebellum, which in their primitive condition have a serial homology.*

There is considerable anatomical evidence for this hypothesis. It has for some years been held (Pawlowsky) that the *posterior commissure* which traverses the constriction between the thalamus and mesencephala is not a commissure in the strict sense of the word, but consists of fibres from the two great tegmental tracts crossing to the opposite side of the brain. Similarly the *superior commissure*, first described independently by Beltoni and myself, also consists of fibres crossing from the thalamus to the opposite hemisphere just in front of the pineal stalk. This commissure is almost constantly developed in the Vertebrata although it has been little noticed hitherto. Finally, the cerebellum, as I have observed in the Urodele Amphibia, in which it is in an extremely primitive condition, is also composed of decussating tracts, uniting the metencephalon (medulla) with the opposite lobe of the mesencephalon. Supporting the anatomical

[1] Abstract read before the New York meeting of the Amer. Assoc. Adv. of Science, 1887, by Dr. Henry F. Osborn.

[2] I do not reckon the epencephalon (cerebellum) as a distinct segment, but as the roof of the metencephalon.

[3] This term has been applied by Dr. Henry Orr, of Princeton, in a paper soon to appear upon the development of the lizard's brain.

evidence is the fact that these three commissures develop nearly if not quite simultaneously, as may be seen in horizontal and vertical sections of the frog's brain, taken in closely succeeding stages. As shown in the accompanying figures, they occupy the three folds which separate the four segments, and appear simultaneously with the anterior commissure. It is noteworthy that the floor of the neural tube, which evidently has no relation with these dorsal commissures, is also the only region in which there are no folds between the vesicles, being interrupted only by the involution of the hypophysis. The inference to be drawn from these facts depends largely upon the question whether there is really a serial homology between the superior and posterior commissures in their primitive condition. If there is, this hypothesis yields some valuable data as to the primitive condition of the encephalon. If there is no such homology between these commissures, there yet remains considerable ground for the supposition that the inter-vesicular folds are simply lines of retarded growth in the walls and roof of the tube to be traversed at an early period by the commissures.—*Henry F. Osborn.*

EXPLANATION OF CUTS.

FIG. 1. Diagrammatic longitudinal section of the frog's brain at an early stage, showing the division of the neural tube into the prosencephalon, *p*; thalamencephalon, *t*; mesencephalon, *m*; and metencephalon, *mt*. The letters are placed in the respective ventricles.

FIG. 2. Camera drawing of a vertical section of the frog's brain at a later stage, showing the dorsal commissures occupying the inter-vesicular folds. *Scm*, superior commissure; *pcm*, posterior commissure; *cbl*, cerebellum; *hph*, infundibulum; *acm*, anterior commissure; *pn*, pineal gland.

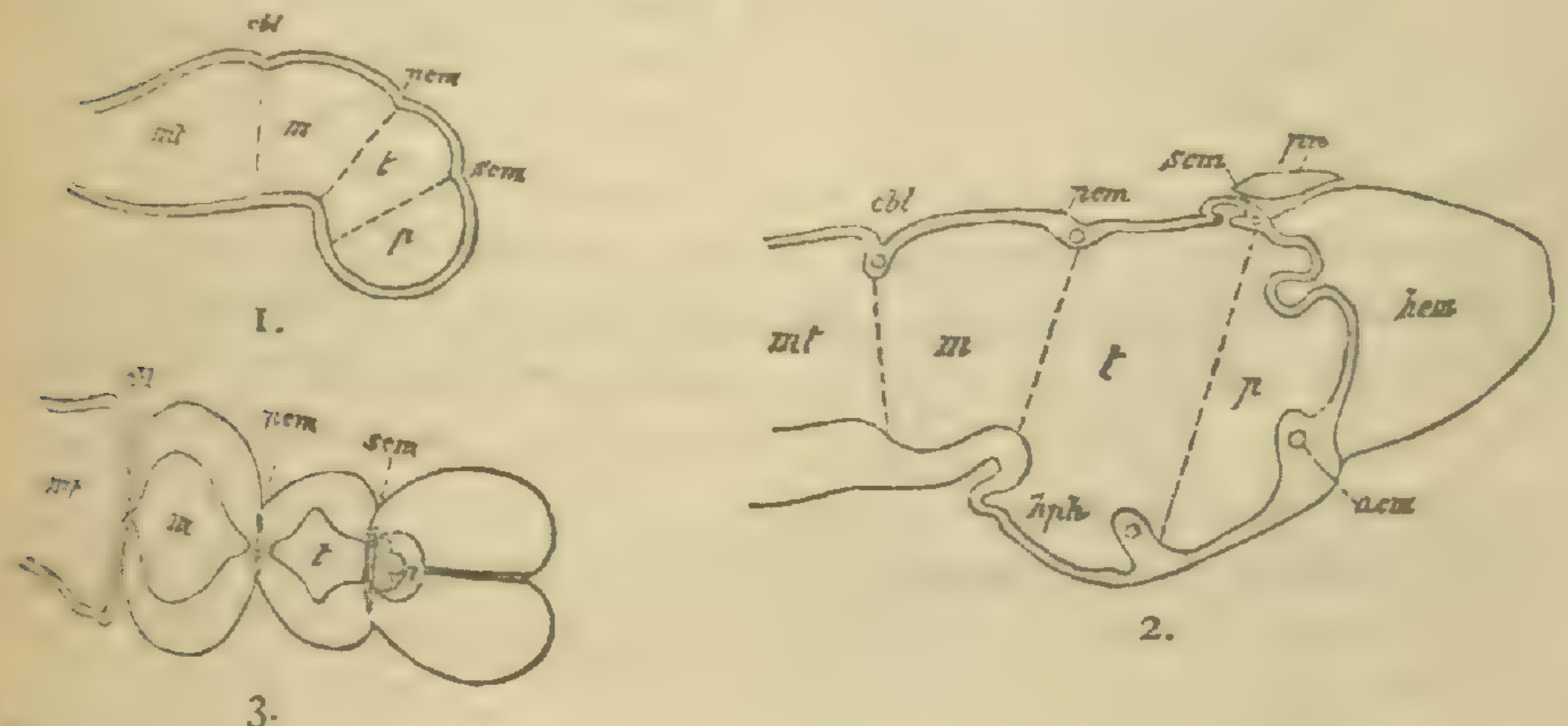


FIG. 3. Camera drawing of a horizontal section of the frog's brain at the same stage, showing the commissures traversing the folds.

The Tongue of Humming-Birds.—In recent ornithological works the tongue of the humming-bird is usually described as a double tube, and is probably used in sucking the nectar of flowers. Recently Dr. Schufeldt has investigated the subject, and in *Forest and Stream* for July 14, 1887, gives the results of his studies. He shows that the account given by MacGillivray in

Audubon's "Birds of America" is correct. The hollow cyl... exist, but each horny tube is completely filled by the cart... nous rod of the glosso-hyal element, and hence cannot be u... sucking. The tongue is, on the other hand, an instrument ... the prehension of small insects. Dr. Schufeldt further ... that in not a single cephalic structural particular do the h... ming-birds agree with the swifts.

On the Morphology of Ribs.[1]—Embryology has shown ... the ribs are developed *between* the mesoblastic somits; they ... therefore *intervertebral.*

The problem now is, how the different modifications of ... position and structure of the ribs derived from that ori... condition.

If we carefully examine the skeleton of Amia, one of ... living Ganoids of this continent, we observe the following: ... the centra of the dorsal vertebræ consist of one piece, the ... terior part of which shows on each side a process where the ... are articulated. The same condition is to be seen in the ... caudals. From the forty-fourth vertebra a change is begun.[2] This and the following vertebra consists of two parts,—an ... terior disk and a posterior one. The anterior represents ... centrum proper, the posterior the so-called intercentrum. ... ontology has shown that in some fishes allied to Amia ... vertebræ show the characters of the caudals of that form; ... do not doubt that we will find in young specimens of Am... dorsal vertebræ divided by a suture separating a vertebra in ... anterior centrum proper and the posterior *intercentrum.* In ... the dorsal vertebræ the rib is connected with a process of ... posterior parts of the centrum,—that is, the *intercentrum.* In the posterior dorsals these processes become smaller, but the ... are always connected with them. From the thirty-sixth ver... the ribs unite below. The processes begin to disappear and ... ribs are now articulated directly with the free intercentra.

The so-called untere Bogen, lower arches, or hæmapophy... of Amia, *are therefore really the ribs.*

In the first caudal vertebræ we find free spines connected w... the distal part of the united ribs; these are co-ossified to th... from the forty-seventh vertebra.

As the ribs or pleural arches are homonomous to the ne... pophyses, or pleural arches, these spines which may be ca... *pleural spines* are homonomous to the neural spines; both ... supporting the unpaired fins.

The same condition is to be seen in *Lepidosteus*, *Cerat...* and *Lepidosiren*,—perhaps in all Ganoidei and Dipnoi.

[1] A paper read before the American Association for the Advancement of Scie... August, 1887.

[2] According to a verbal communication of Professor Zittel.

From that fact Gegenbaur reached the general conclusion that the ribs of all vertebrates are nothing else than the modifications of the lower arches, the hæmapophyses; or, reversed, that the hæmapophyses are ribs.

Now, anybody who examines a young skeleton of Alligator or Necturus will find that in the caudal vertebræ *ribs are present besides the lower arches*, hæmapophyses, or chevrons.

That the processes of the caudal vertebræ, which are free in young animals, are true *ribs* can easily be proved on a skeleton of a young Sphenodon.

There are no lumbar vertebræ in Sphenodon, all the presacral vertebræ have well-developed ribs, but the posterior ones are uniting later with the vertebræ. The two sacral vertebræ and the anterior caudals show exactly the same condition; in the young animals the elements are free, but unite later with the vertebræ.

In the caudals we find, besides these ribs, well-developed hæmapophyses, or intercentra. The nature of these chevrons has been examined by Professor Cope and myself: they proved to be nothing else than processes of the intercentra united below; the same processes as those in Amia on which the ribs articulated. *Therefore the lower arches, which enclose the subcaudal blood-vessels, are either formed by true ribs or by processes of the intercentra.*

Gegenbaur was wrong in relation to the Stapedifera. Claus was right in that, but did not give any explanation of the condition in fishes.

I shall try to explain all the difficulties.

There is no doubt that the original condition is to be seen in a form like Amia of the Ganoids.

Gegenbaur has shown that in many Teleostei the lower arches are not formed by the ribs, as in Amia, but by processes of the vertebræ, to which the ribs can be articulated. This condition can be seen in the given figures.

Exactly the same must have taken place in the higher Vertebrata. The processes of the intercentra became larger, until they united below, the ribs were pushed out of place and dislocated, not only to the centrum proper but also to the neural arch.

We have on hand all transitions between the caudal vertebræ of a form like Amia and the Teleostei. But the forms connecting the Dipnoans with the same structure of the caudal vertebræ as Amia and the lowest Batrachia, in which the lower arches are formed by the intercentra, as in all other Stapedifera, are still missing.

The Ribs of the Batrachia and Amniota.—In *Archegosaurus* the ribs of the dorsal region are not connected with the well-developed intercentra, but with diapophyses of the neural arches. In the cervical region the articular surface for the rib is continued

downwards, forming a groove on the posterior part of the s... of the intercentrum. Therefore the single-headed ribs of Arch... gosaurus articulate in the anterior region of the vertebræ w... both the intercentrum and neurapophysis, in the posterior re... with the neurapophysis only.

In the living Batrachia the double-headed ribs are articulat... to double-headed diapophyses of the neurapophysis.

Therefore in the Batrachians the ribs have been translocated f... the original position on the intercentrum to the neurapophyses.

Whether the Batrachian centrum represents the centrum proper or the intercentrum, as Professor Cope is inclined to believe, cannot yet be determined. *Sphenosaurus* certainly is not a connecting form, but a true reptile, as I have proved.

The Ribs of the Amniota.—Signs of the original condition of the ribs, as seen in Amia, are still preserved in the Permian Pelycosauria, the Sphenodontidæ, and the Mammalia.

In the Pelycosauria the ribs are connected with the well-developed intercentra; there would be no difference from Amia if the ribs were not two-headed. A second head is developed on the tuberculum, touching the centrum of the vertebræ. The tuberculum is certainly a secondary development of the rib, going hand in hand with the rudimentation of the intercentrum, giving a better connection to the rib. The rib-articulation of *Sphenodon* is the same as in the Pelycosauria, but the tubercular articulation is more developed, the capitulum in a rudimentary form being transformed to ligament.

The same type we find in the Mammalia, as mentioned by Professor Cope, where the capitular articulation is between two vertebræ in an excavated fossa. The intercentrum has become rudimentary or disappeared entirely.

The one-headed ribs of the Lacertilia, Pythonomorpha, Ophidia, have originated from the condition seen in Sphenodon. The capitulum has gone entirely.

The two-headed ribs of the Ichthyosauria, Crocodilia, Dinosauria, Ornithosauria, have developed from a form like Sphenodon, in which the capitulum was still ossified, but was already transported from the rudimentary intercentrum to the centrum proper. This translocation has gone still further, in a way that both capitulum and tuberculum are at least situated on the neurapophysis.

All stages of this gradual wandering of the ribs can be observed in the vertebral column of a crocodile.

The first vertebra has a single-headed rib, connected with the intercentrum, as in Amia. The posterior dorsal have the two-headed ribs connected with well-developed dia-parapophyses of the neural arch. Between the condition found in the atlas and that in the posterior dorsals all stages can be seen in the intermediate vertebræ.

The results of the present paper are:

1. The ribs are developed *between* the myocomata; they are, therefore, *intervertebral.*

2. The ribs are originally one-headed and connected with well-developed intercentra.

3. All forms and connections of the other ribs can be derived from that condition.

4. The lower arches of the caudal vertebræ are either formed by true ribs, the oldest fishes (Ganoidei, Dipnoi), or by processes of the intercentra (Teleostei, Stapedifera).

5. The connection between the Dipnoans and the Stapedifera is still missing.

6. Some remarks on the nomenclature of the elements of the vertebral column.

Owen's names, "neurapophysis" and "pleurapophysis," are not correct; the neural and pleural arches are no processes of the vertebræ, but are distinct parts.

The two elements composing the neural arch ought to be called the "*neuroids*;" the two elements composing the pleural arch, the "*pleuroids.*"

The spines connected with the neuroids ought to be called, as before, *neural spines;* those connected with the pleuroids, *pleural spines.*

The real centrum of the vertebra ought to be called *centrum;* the lateral elements composing it, *hemicentra* (Albrecht), not pleurocentra.

The name intercentrum ought to be preserved.

The part of the intercentrum, centrum, or neuroid to which the capitulum is articulated, may retain the name *parapophysis;* the part of the centrum or neuroid to which the tuberculum is articulated, may retain the name *diapophysis.*—*Dr. G. Baur, New Haven, Conn.*, 1887.

Zoological News.—Lower Invertebrates.—Dr. A. C. Stokes describes some more new species of North American Hypotrichous Infusoria in the *Annals and Magazine of Natural History.*

Crustacea.—At a recent meeting of the Linnean Society of New South Wales, Mr. John Mitchell called attention to the fact that some of the Australian species of trilobites of the genus Acidaspis differ from the diagnosis of the genus in having the eyes faceted (not smooth) and the facial suture discontinuous.

Dr. W. Lilljeborg, of Upsala, has worked up the Entomostraca collected by Dr. Leonard Stejneger in his late expedition to the Commander Islands. The results appear in the *Proceedings of the United States National Museum.* Only two new species, *Eurycercus glacialis* and *Diaptomus ambiguus*, are described. *Calanus cristatus* Krŏyer is reported as exceedingly abundant, their dead bodies forming long windrows on the beaches.

MYRIAPODS.—Mr. Chas. H. Bollman has recently published several papers on North American Myriapods. One, entitled "Notes on the North American Lithobidæ," appears in the *Annals of the New York Academy of Sciences*. In it he describes as new *Lithobus minnesotæ*, *tuber*, *proridens*, *pullus*, *trilobus*, *cardinalis*, *howei*, *politus* (McNiell MS.), and *clavus* (McNiell MS.). This is followed by a synonymical list of the known species of North American Lithobidæ and Scutigeridæ. A second paper—"Notes on North American Julidæ"—appears in the *Annals of the New York Academy* (vol. iv.). The author catalogues ninety-two species of the family known from North America, including the following new species: *Julus oweni*, *Spirobolus pensacolus*, *S. hebes*, *Parajulus ellipticus*, *P. castaneus*, *P. obtectus*, *P. varius*, and *Nanolene* (nov. gen.) *burkei*.

FISHES.—Jordan and Eigenmann, in an account of a collection of fishes from Charleston, S. C. (*Proc. Nat. Mus.*, 1887), enumerate fourteen species, nine of which were not previously known from that locality.

In a paper on the fishes of Kansas, Prof. O. P. Hay describes as new *Notropis æneolus* and *N. germanus*, and suggests that the genus Tirodon Hay was founded on a specimen of *Hybognathus nuchalis* with abnormal dentition.

C. Eigenmann and Jennie E. Hornung contribute to the *Annals of the New York Academy* a revision of the North American species of Chætodontidæ. They recognize fourteen species distributed in the genera Prognathodis, Chætodon, and Pomacanthus.

BIRDS.—The large collection of humming-birds made by Mr. D. G. Elliot and which formed the basis of his recent monograph has passed into possession of the American Museum in New York City. The museum has also acquired his ornithological library of about one thousand volumes.

Dr. Leonard Stejneger is publishing in the *Proceedings of the National Museum* an exhaustive review of the birds of Japan. In the same journal Mr. Robert Ridgway has recently described a new sub-species of plumed partridge (*Callipepla elegans texsoni*) from Sonora. His material consisted of five specimens.

EMBRYOLOGY.[1]

Spermatogenesis in Mammalia.[2]—The interest which attaches to the development of the spermatozoon, from the stand-point of the embryologist, is not less than that which attaches to the

[1] Edited by JOHN A. RYDER, Ph D., Biological Department, University of Pennsylvania, Philadelphia.

[2] Untersuchungen über den Bau des functionirenden Samenkanälchens einiger Säugethiere und Folgerungen für die Spermatogenese dieser Wirbelthierklasse. Arch. f. Mik. Anat., xxx., 1887, pp. 49–110. Taf. v.–vii. Von Dr. Carl Benda, Berlin.

development of the ovum (ovogenesis), or of the embryo itself (ontogenesis), since spermatogenesis and ovogenesis are processes which involve the maturation of the elements which enter the formation of the fertilized ovum or oösphere. All of these processes are therefore properly comprehended under ontogeny or embryology in its widest sense.

Dr. Benda's carefully-elaborated memoir deals with the development of the spermatozoa in *Sus*, *Mus*, *Lepus*, *Cavia*, *Bos*, *Canis*, and *Felis*; the peculiarities in each case are figured and discussed by the author, but the present writer must content himself by giving a *résumé* of the results and conclusions. The following is a synopsis of Dr. Benda's conclusions, as nearly as possible in his own words:

1. The seminal tubuli of the mammalian testis contain two kinds of histological elements, which are distinct in function,—the *Stammzellen*, or spermospores, with their derivatives (mother-cells, spermatoblasts, etc.), and the "supporting cells" (H. H. Brown), or Fusszellen (Benda).

2. Their functional activities are exhibited in four acts,—1. The multiplication of the *Stammzellen* (spermospores); 2. The production of spermatoblasts from a part of the spermospores; 3. Copulation or union of the "supporting cells,"—*Fusszellen* with a number of spermatoblasts; and 4. The conversion of the spermatoblasts, which have united with the supporting cell, into spermatozoa.

3. These four processes take place successively and continuously (*schübweise*).

4. The multiplication of the spermospores is effected by indirect cell-division in the outer cell-layer of the seminal tubule.

5. The production of a crop of spermatoblasts follows preparatory changes of place of the spermospores and their conversion into substitutional mother-cells (*Ersatzmutterzellen*) and mother-cells through indirect cell-division in the inner cell-layers of the seminal tubuli.

6. After the formation of a generation of spermatoblasts, each of the functional "supporting cells," which lie next the outermost wall of the tubuli, conjugate with or become joined to a number of spermatoblasts.

7. Simultaneously or immediately after this conjugation has been established, the spermatoblasts are converted into spermatozoa.

8. This metamorphosis of the spermatoblasts consists in the conversion of their nuclei into the various organs of the spermatozoa, and the solution of the cell-body or their investment.

9. The rudiments of the organs of the spermatozoon arrange themselves with reference to the point of conjugation, in that the nearest part of the nucleus will become the head and the remotest the tail.

10. The spermatoblasts, during the entire metamorphosis remain in organic union with the supporting cell, and, through active and passive changes in the latter, are formed into a bundle of spermatozoa.

11. The extrusion of the spermatozoa from the wall of the tubule follows spontaneous or active severing of their connection with the supporting cell, and by lateral pressure from the growing adjacent elements.

12. The various acts of secretion, in every portion of the tubuli, overlap in an orderly manner, and in such wise that at definite points the successive phenomena coincide in time.

If we assume the period of metamorphosis of a spermatoblast as a measure of time, we have

a. The close of each period of metamorphosis of the spermatoblasts marks the beginning of the multiplication of the spermospores.

b. The beginning of the period of metamorphosis coincides with the preparatory changes in the spermospores for the production of spermatoblasts.

c. The preparation for the production of spermatoblasts always corresponds to two periods of metamorphosis; and there are always two crops in process of formation.

d. With the close of each period of metamorphosis there corresponds a generation of spermatoblasts, so that at the close of the metamorphosis, in the same tubule, the material for the next period lies in readiness.

13. In every portion of a testicular tubule a periodic secretion of spermatozoa and an uninterrupted succession of periods of secretion is possible.

14. The periods of secretion in different tubules do not coincide.

15. By means of a uniform alternation of the periods of secretion in the different portions of the tubuli, the conditions are supplied for a continual secretion of semen by the whole testis of a mammal.

PSYCHOLOGY.

Scientific Theism.[1]—In this book by Dr. Abbot we have an attempted reconciliation between Science, Philosophy, and Religion, in accordance with the scientific doctrine of evolution. As one of the first, if not the first, rational endeavor in this direction, from the stand-point of Philosophy, the book is a noteworthy one. The subject is treated of under three divisions —viz., a long historical introduction; a part I., on the "Philosophy of Science;" and a part II., on the "Religion of Science." The position of the author is that of Scientific Realism, or Relationalism, as he terms it, as opposed to Idealism or Pure

[1] "Scientific Theism;" by Francis Ellingwood Abbot, Ph.D. Boston: Brown & Co. 2d edition; 8vo.

ism. This Realism is not that of the Schools, but is intermediate between it and its opposed Idealism. In other words, relations are not regarded in the wholesale manner in which they were treated by the Idealists, who asserted them to be purely subjective, and by the Realists, who declared them to be entirely objective; but they are analyzed scientifically into their essentials, objective realities, and subjective generalizations or ideas. On this eminently sound basis Dr. Abbot harmonizes philosophical and scientific thought. His statement of the leading positions in the controversy is as follows (p. 23):

"1. EXTREME REALISM (*Universalia ante rem*) taught that universals were substances or things, existing independently of and separable from particulars or individuals. This was the essence of Plato's 'Theory of Ideas,' and Plato was the father of extreme Realism as held in the Scholastic Period. Scotus Erigena, who died A.D. 880, was the first to revive this doctrine in the Schools, borrowing from the Pseudo-Dionysius Areopagita.

"2. MODERATE REALISM (*Universalia in re*) also taught that universals were substances, but only as dependent upon and inseparable from individuals, in which each inhered; that is, each universal inhered in each of the particulars ranged under it. This was the theory of Aristotle, who held that the τόδε τι, or individual thing, was the First Essence, while universals were only Second Essences, real in a less complete sense than First Essences. He thus reversed the Platonic doctrine, which attributed the fullest reality to universals only, and merely a 'participative' reality to individuals. Until Scotus Erigena resuscitated the Platonic theory, Aristotle's was the received doctrine in the Schools, and the warfare was simply between those two forms of Realism prior to the advent of Roscellinus.

"3. EXTREME NOMINALISM (*Universalia post rem*) taught that universals had no substantive or objective existence at all, but were merely empty names or words (*nomina, voces, flatus vocis*). Though probably not the absolute originator of this *sententia impia*, as the doctrine came to be called, Roscellinus, Canon of Compiègne, was the first to give it currency and notoriety, and the Council of Soissons, under the influence of the Realist Anselm, of Canterbury, his chief opponent, forced him, in the year 1092, to recant the tri-theistic interpretation of the Trinity, which he had consistently and courageously avowed. The theory of Extreme Nominalism was thus put under the ecclesiastical ban.

"4. MODERATE NOMINALISM, or CONCEPTUALISM (*Universalia post rem*), taught that universals have no substantive existence at all, but yet are more than mere names signifying nothing; and that they exist really, though only subjectively, as concepts in the mind, of which the names are the vocal symbols. Abailard is claimed by some, but probably incorrectly, as the author of

this modification of the nominalistic view; William of Occam, who died in 1347, seems to have been the chief, if not the earliest, representative of it. The 'Encyclopædia Britannica,' xvi. 284, 8th edition, says, 'The theory termed Conceptualism, or Conceptual Nominalism, was really the one maintained by all succeeding Nominalists, and is the doctrine of ideas generally believed in at the present day.'

"5. Albertus Magnus (died 1280), Thomas Aquinas (died 1274), Duns Scotus (died 1308), and others fused all these views into one, and taught that universals exist in a threefold manner, —*Universalia ante rem*, as thoughts in the mind of God; *Universalia in re*, as the essence (quiddity) of things, according to Aristotle; and *Universalia post rem*, as concepts in the sense of Moderate Nominalism. This is to-day the orthodox philosophy of the Catholic Church, as opposed to the prevailingly exclusive Conceptualism of the Protestant world.

"Thus both Extreme Realism and Moderate Realism maintained the objective reality of genera and species, while both Extreme Nominalism and Moderate Nominalism maintained that genera and species possess no objective reality at all.

"In contrast with all the views above presented, another and sixth view will now be stated, which, taken as a whole, and with reference to the vitally-important consequences it involves, is believed to be both novel and true.

"6. Relationalism, or Scientific Realism (of which *Universalia inter res* may be adopted as an apt formula), teaches that universals, or genera and species, are, *first*, objective relations of resemblance among objectively-existing things; *secondly*, subjective concepts of these relations, determined in the mind by the relations themselves; and, *thirdly*, names representative both of the relations and the concepts, and applicable alike to both. This is the view logically implied in all scientific classifications of natural objects regarded as objects of real scientific knowledge. But, although empirically employed with dazzling success in the investigation of Nature, it does not appear to have been ever theoretically generalized or stated."

In his discussion of Idealism Dr. Abbot shows that no school of this type is or has been consistent excepting that of Hegel, the outcome of which is the well-known "existence and non-existence are identical."

In his section on the "Religion of Science" Dr. Abbot shows that he is on a hot trail; but we think that he does not quite reach his goal. The key to his argument is found in the following passages of the summary of this part of his views (p. 208):

"2. Because (the Universe) is infinitely intelligible, it must be likewise infinitely intelligent.

"3. Because it is at the same time both infinitely intelligible

and infinitely intelligent, it must be an infinite subject, object, or self-conscious intellect."

We do not perceive that the inference expressed in 2 (above) is a necessary one; in fact, it is obtained by a confusion of object with subject; therefore 3 cannot be sustained.

We heartily agree with the following brief survey of scientific philosophy (p. 200): "The dualistic and teleological philosophy of Paley belongs to the past; the mechanical and monistic philosophy of Spencer and Haeckel belongs to the present, but is rapidly moving into the past; the *teleological and monistic* philosophy of the scientific method and the organic theory of evolution belong to the future, and will soon be here." We add to this our own belief that a part of this philosophy is contained in Dr. Abbot's book; that some of the rest of it is also here we will endeavor to show in the next number of the NATURALIST.—*E. D. Cope.*

MICROSCOPY.[1]

The Naples Water-Bath.—Drs. Mayer,[2] Giesbrecht, and Vosmaer have recently constructed a new water-bath for imbedding in paraffine, which differs in many particulars from the one hitherto employed in the Naples Zoological Station. H. Jung, of Heidelberg, furnishes the whole apparatus, including a small water-bath for imbedding under the simple microscope, at sixty-five marks (sixteen dollars and twenty-five cents). In this price the regulator is reckoned at eight marks and each thermometer at two and a half marks. Orders for the water-bath and its accessories are filled by the Educational Supply Co., 6 Hamilton Place, Boston.

This is the most thoroughly equipped water-bath that has thus far been described, and it is admirably well adapted, in size and shape as well as outfit, to those micro-technical uses for which it was designed.

One of the more important improvements in the outfit is the new Bunsen burner (*r*), which consists of a horizontal tube, to one end of which is attached a short, vertical gas-burner. The burner is fixed in a movable stand 3.5 cm. high. The gas-burner only rises to the height of the stand, so that the bath requires to be raised only 4 cm. The bath is thus placed at a height most convenient for work and most favorable to economy of heat. The flame does not smoke, and does not strike back when reduced to its lowest point. With a maximum flame the bath, which has a capacity of 2.5 litres, is brought to a temperature of 60° C. in thirty to forty-five minutes.

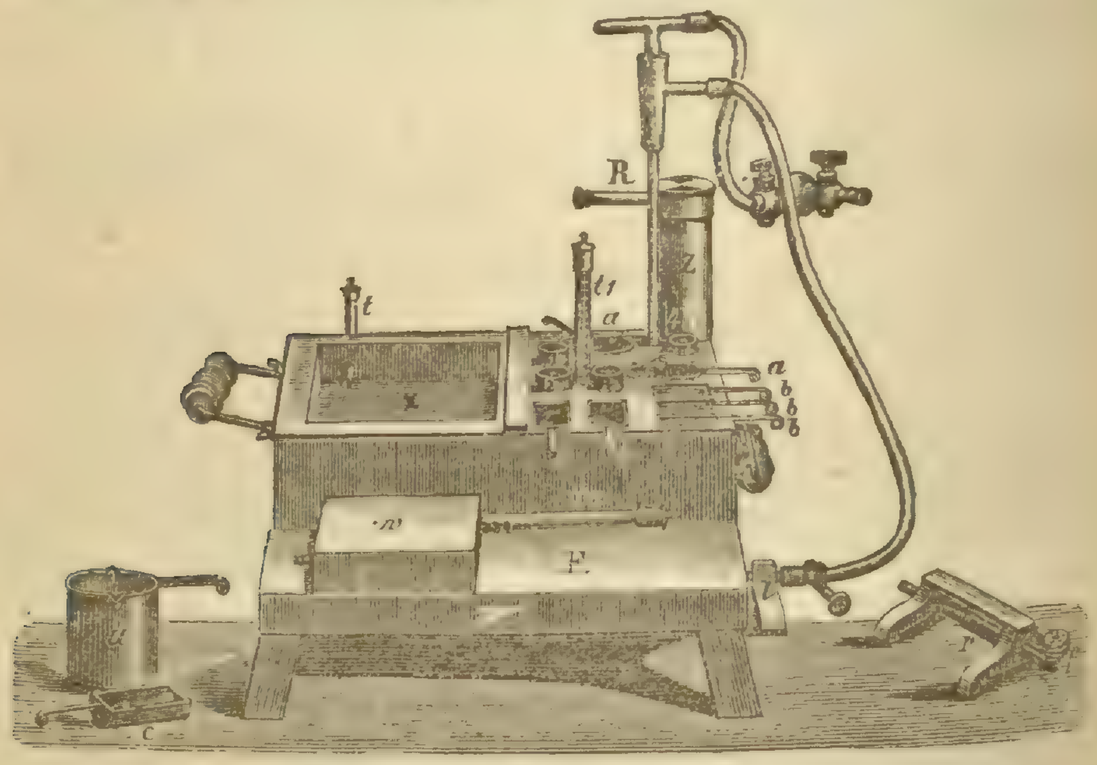
Another important attachment of this water-bath is the thermo-regulator. A full explanation of this part is furnished with each

[1] Edited by C. O. WHITMAN, Milwaukee, Wisconsin.

[2] Dr Paul Mayer, "Aus der Mikrotechnik," *Internationale Monatsschrift f. Anat. u. Phys.*, iv., H. 2, 1887.

instrument. By means of the regulator the temperature can be kept very nearly constant day and night, the variation being less than one degree with a uniform gas-pressure.

The bath is filled (best with distilled water) through the tube Z, which can be unscrewed for transportation. The tube is made large to guard against the overflow of water during heating, and is covered with a cap to protect aginst dust and to prevent evaporation. While pouring in the water, the bath should be held a little obliquely, so as to allow the air to escape, and the receiving-tube should be left empty.



The deep basins (*a*) are designed for keeping a ready supply of melted paraffine, while the smaller, half-cylindrical basins (*b* and *c*) serve to hold the objects during the process of infiltration with paraffine, or, if the term may be allowed, during the process of *paraffinizing*.[1]

For imbedding very large objects special dishes may be required. Large watch-glasses, or better glass dishes, serve well for such objects, and they can be kept in the large air-bath (*x*). Suitable dishes can also be made by any tinman from white iron-plate. Brass dishes are not recommended, as they are corroded by turpentine.

The air-bath, when kept open, has a temperature about ten degrees lower than that of the water-bath, and is thus a convenient place for the slow evaporation of chloroform, benzol, etc. It is only necessary for this purpose to place the dish containing the paraffine solution and the object on some support (*e.g.*, a cork ring) that will keep it from contact with the bottom or sides of the air-bath.

[1] After the analogy of albuminize, paraffinize would mean to cover, or impregnate, with paraffine.

The small water-bath, for imbedding minute objects under the microscope, has two openings, each of which is connected with a caoutchouc tube about 50 cm. long. The bath is filled by placing one of these tubes in a basin of water and sucking through the other. When the bath is full, the second tube is placed with the first in the basin of water, and the bath is heated on the table (F) or in the air-bath (x), the burner being used, eventually, to aid in bringing the temperature to the point desired. The watch-glass or other glass dish containing the object in melted paraffine is next placed on the bath, with a slip of white or colored paper, according to need, beneath it; and the orientation of the object is then undertaken with the greatest ease. This accomplished, one of the caoutchouc tubes (the lower) is removed from the basin of water and allowed to hang over the corner of the work-table; the hot water is thus drained off and replaced with cold, so that the paraffine cools quickly without the least disturbance of the object.

SCIENTIFIC NEWS.

—The "Circolo degle Aspiranti Naturalisti" of Naples will hereafter be known as the "Societa dei Naturalisti." With this change in name they begin the publication of a bulletin.

—Dr. Pierre, after many years of labor, has completed his work on the Flora of Cochin China. In recognition of this fact the government of the province has granted him a life pension of six thousand francs.

—Dr. W. Zoff has been appointed ordinary professor of botany in the University of Halle.

—Dr. G. Berthold accepts the position of ordinary professor of botany at Göttingen.

—Dr. Karl Brandt, of Königsberg, becomes interim director of the Zoological Institute of the University of Kiel.

—Dr. E. Korschelt, of Freiburg, has been appointed assistant in the Zoological Institute of the University of Berlin.

—In the January number of the AMERICAN NATURALIST we noted the death of Edgar von Harold, one of the authors of the valuable "Catalogus Coleopterorum." Dr. Max Gemminger, his associate in that laborious undertaking, has since died. For many years he had held the position of conservator of the Zoological Museum at Munich.

—Edward T. Hardman, a member of the Geological Survey of Ireland, died in Dublin, April 30. In 1883–86 he travelled extensively in West Australia, and added not a little to our knowledge of the geological features of that region.

—Dr. John Frenzel, of Berlin, sailed July 20 to take the position of professor of zoology and director of the museum in Cordova, Argentine Republic.

—The late Richard Cranch Greenleaf, who died recently in Boston, bequeathed his microscopical library, microscopes, and apparatus to the Boston Society of Natural History.

—The Liverpool marine biological committee has enlarged the field of its operations. The sewage in the neighborhood of the city rendering the study of the fauna and flora a matter of some difficulty, they have, therefore, built a laboratory on Puffin Island, an uninhabited island near Anglesea. The building contains seven rooms and is well adapted for its purposes.

—Mr. James C. Pilling, of the Bureau of Ethnology, has for some time been collecting materials for a bibliography of North American Linguistics. He has now nearly completed the portion relating to the Eskimo languages, and this will be published as a bulletin by the Bureau.

—William Boott, who died in Boston May 16, 1887, was born in that city June 15, 1805. Like his brother, the late Francis Boott, he was a botanist, and devoted himself to the difficult groups of grasses and sedges. His botanical collections go to the herbarium of Harvard University.

—The translation of Reiss and Steubel's "Necropolis of Ancon, Peru," is now completed, and makes three volumes, illustrated by one hundred and forty-one colored folio plates. A separate volume, complete in itself, is now in preparation.

—W. L. Sclater, of Oxford, England, has been appointed deputy superintendent of the Indian Museum in Calcutta, thus filling the place left vacant by the promotion of Mr. J. Wood-Mason to the superintendency.

—Mr. James E. Humphrey, assistant in the botanical laboratory of Harvard University, has been appointed instructor in botany in Indiana University, Bloomington, Ind.

—Recent Deaths.—Henri Brisout de Barneville, entomologist, at St. Germain-en-Laye, January 23; Thomas Wilson, entomologist, at York, England, April 17; John Gatcombe, ornithologist, at Plymouth, England, April 28, aged sixty-seven; John Hellins, student of British Lepidoptera, at Exeter, England, May 9, aged fifty-eight; Sir Walter Elliot, of London, a student of the Mammalia of India; F. A. Vulpian, physiologist, and secretary of the Academy of Sciences of Paris, May 17, aged sixty-one years; Professor Moritz Wagner, of Munich, a zoological traveller and writer upon evolution, May 31, aged seventy-three years; Robert Gray, the well-known ornithologist of Edinburgh, February 18; Professor Bernard Studer, geologist, at Bern, Switzerland, May 2, aged ninety-three.

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THE MATERIALS OF THE APPALACHIANS.

BY E. W. CLAYPOLE, AKRON, OHIO.

PENNSYLVANIA consists almost entirely of massive palæozoic deposits of sand and shale with a few limestones. These beds united reach a thickness greater than do those of the same age in any other known part of the world. Reasonably accurate measurements have given them a total depth in some places of thirty thousand to forty thousand feet. Westwardly they thin off, and on the Ohio line scarcely reach one-fourth part of this enormous depth.

All geologists are agreed that this immense mass of sediment was deposited on the slowly subsiding bottom of the eastern part of an ocean covering the whole interior of North America,—the North American palæozoic ocean, as it may be called for convenience. The extent and form of this ocean varied considerably at different times during its long existence, but taken as a whole it was uninterrupted sea.

It is further a geological truth, so evident as to be now axiomatic, that all this vast mass of palæozoic deposit was obtained by erosion from some contemporaneous palæozoic land. Deposition implies erosion to a precisely equal amount. For every ton of sand or mud deposited on the sea-bottom an equivalent ton has been removed from some land-surface. Sediment is not created. It is only removed. Hence all these huge Appalachian beds from which the mountains have been since carved imply the destruction of exactly equal masses of some more ancient land elsewhere.

It is further admitted, at least, I think, by all Pennsylvania geologists, that this ancient land, whose destruction supplied the materials for these immense deposits, existed to the east and southeast of the Appalachian region. It is sufficient to mention the increasing thickness of the strata towards the southeast and the greater coarseness of their material in the same direction, to convince almost every one that the palæozoic land must be sought there.

Having laid down these premises, I propose first to notice the immense mass of the Appalachian deposit.

Pennsylvania contains at present about forty thousand square miles of surface. Of this about nine-tenths are covered with the palæozoic rocks; that is, about thirty-six thousand square miles. Since their elevation above water erosion has destroyed vast quantities, but, as said above, there is positive evidence that when they lay in horizontal sheets beneath the ancient ocean they measured from eight miles at the east to three miles at the west in depth. It cannot, therefore, be excessive to assume this western measurement as an average over the whole area. If this be done, we find the palæozoic deposits of Pennsylvania represented by a mass three miles thick and thirty-six thousand square miles in area.

This estimate is far below the truth for the following reasons:

1. As mentioned above, nearly the minimum thickness is employed over the whole area.

2. Vast quantities of material now lying outside of Pennsylvania, in Ohio and Western New York, are omitted.

3. The corrugation and consequent contraction of the surface during the formation of the Appalachian earth-folds are disregarded.

The importance of this last fact must not be overlooked. In a paper by the author, read before the British Association at Montreal in 1884, and printed in the AMERICAN NATURALIST for March, 1885, the great diminution of surface which the region in question underwent during the process of crumpling was pointed out. Palæozoic Pennsylvania was far larger than the existing State. Could the strata be flattened out her area would be much increased. Could we iron out—to borrow a term from the laundry—her anticlines and synclines thousands of square miles would be added to her size. The distance from Pittsburg to

Harrisburg would be greater by many miles. The present Keystone State bears to the original palæozoic Pennsylvania somewhat the relation which the skin of a shrivelled apple or potato bears to the same skin when plump and fresh. But of this no account is taken in the estimate given above.

Turning now to the consideration of the land from which all this sediment was derived, we find that only about one-tenth part of the State can have been above water in palæozoic days, and that this small portion lay in the southeastern corner. All the rest is covered with palæozoic rocks. This means that the only visible source of the material of which these rocks are composed and which we have found is a mass of at least thirty-six thousand square miles in surface and three miles thick, is an area in Pennsylvania of four thousand square miles. Restore in imagination these massive sheets of rock to their original source, and it will be necessary to pile the material twenty-seven miles high on the palæozoic land of the State in order to obtain a sufficient supply,—in order to build a quarry from which the rivers and sea-waves of that age could cut out the blocks which, when torn up and scattered, have composed the palæozoic rocks of Pennsylvania.

A correction may be made in the above figures on account of the probability that some of these sediments came from New Jersey on the northeast and Maryland on the south. Parts of both these States consist of archæan terranes now exposed and of others now covered with later mesozoic red sandstones. But if all the areas in both States are added to the possible archæan surface of Pennsylvania, they will not more than double it, and we shall still be compelled to assign an enormous depth (thirteen miles) to the eroded ancient land before sufficient material is at hand to form the palæozoic strata of Pennsylvania.

This, then, is the main factor in the great problem under consideration, the vastness of the mass that has been obtained from the archæan area in the southeast. I wish to take up now only a portion of the subject, one which can be treated in the short space here available. Among these heavy deposits there are, omitting some thin and local beds, four great sandstones, more or less pebbly. They are as follows in descending order:

The Pottsville Conglomerate, Carboniferous.

The Catskill-Pocono Conglomerate, Upper Devonian and Lower Carboniferous.

The Oriskany Sandstone, Lower Devonian.

The Medina Sandstone, Middle Silurian.

All these vary much in thickness in different places, but all are thickest and heaviest and contain the largest pebbles in the eastern or southeastern part of the district, and all thin out, more or less, towards the northwest. To assign to them an average thickness that would satisfy every one is, probably, impossible, but the following attempt will be exact enough for my present purpose. No doubt can be entertained of their original extension over the whole Appalachian area, though all four have since been largely eroded.

The Medina, with the Oneida, maintains its mass over most of its exposures in the State, showing less diminution westward than some of the other strata. It is two thousand feet deep in the Kittatinny, and more than that in the Bald Eagle Range; so that an average of one thousand feet may be safely assumed.

The Oriskany is the thinnest of the four, but its extent is not less than that of the others. In some places it reaches three hundred feet in thickness, but is usually much less. It may be therefore thrown out of our estimate of thickness altogether.

The Catskill—most massive of all, reaching seven thousand feet in many places, consisting of sandstone and shale, and maintaining at its last descent beneath the Alleghany Mountains a thickness of two thousand six hundred feet—may, without danger of exaggeration, be considered the equivalent of another bed of sandstone one thousand feet thick.

The Pocono, varying from more than one thousand feet in the east to two hundred feet in the west, may represent another five-hundred-foot mass.

A similar thickness may be given to the Pottsville, or Carboniferous Conglomerate, and we shall then have, as the equivalent of the great palæozoic sandstones of Pennsylvania, about three thousand feet of sandstone,—a low estimate.

The Catskill and Pocono, having no soft beds between them, may, for our present purpose, be counted as one sandstone mass.

In all these sandstones a part of the mass consists of pebbles of milky quartz. This feature in the Pottsville, Pocono, and Lower Medina is so strongly developed that they usually bear

the name of Conglomerates. The pebbles vary in size from that of a man's fist or larger in the east to that of a hazel-nut or a pea in the west; but they extend over the whole area, and form a considerable part of the mass of the rock. They are as conspicuous in Ohio as in Pennsylvania, and everywhere closely resemble one another.

It would be impossible to form any just estimate of the quantity of these pebbles in the mass of the sandstone. In the first place, their occurrence is uncertain. Over large areas much of the rock is free from them, except in certain, or rather in uncertain, layers; and, secondly, almost everywhere except in the east their proportion, even in the conglomeratic beds, is very variable. Not unfrequently they form seventy-five per cent. of the stone; at other times only an occasional pebble is present. But, scattered as they are over so great an area and through so great a thickness of strata, their whole quantity must be enormous. Were we to assume that they compose only one per cent. of the rock they would equal a bed thirty feet deep, with an area of thirty-six thousand square miles.

Moreover, their rounded form, without a remaining angle in any case, proves two points,—first, that the surviving pebbles have been greatly rubbed down from their original size, especially in the west, and, second, that innumerable fragments have not survived at all, but have been ground into sand by the wear and tear of their long pilgrimage over the ocean-bottom or beach.

In whatever way we regard them, and from whatever point of view, no doubt can be entertained that these pebbles of our Pennsylvania Conglomerates represent, in the whole, a huge mass of milky quartz, and that this, in like manner, represents a larger mass of the same material, from which, by crushing and rolling, they have been derived. Every one is a monument, so to speak, to the memory of an angular block, broken, at some far-distant day, from its parent-ledge, and rolled for years among stones and sand until it was reduced to a smooth, small pebble, and buried to rest in the Conglomerate Rock.

Where was this mass of milky quartz, the parent of the uncounted pebbles of the Conglomerates of Pennsylvania? Milky quartz is not a common mineral in large quantities. I know no source to which they can be ascribed except certain ledges of

this material in the South Mountains, where the pre-palæozoic rocks rise to-day from beneath the overlying strata.

Here, and here only, in Southeastern Pennsylvania can be found the white vitreous quartz of which they are uniformly composed. No other rock can have supplied them. There is abundance of quartz in the gneisses near Philadelphia, and in Chester and other counties, but this quartz is not of the kind from which these pebbles are made, nor does it occur in masses sufficiently large to supply them. Some of the other materials of the palæozoic sandstones may be ascribed to the destruction of the gneiss-rocks. For the white pebbles, however, this origin is not possible.

But though I have thus tracked these pebbles of the Pennsylvanian Conglomerates to their only possible source in the southeast, a serious difficulty stands in the way of further progress. I have, without giving figures, dwelt on their enormous quantity and the vastness of the mass of quartz which they represent. Now, the quartz-ledges of the old rocks in the South Mountains are not thick, measuring only a few feet in most cases. Nor are they numerous. They could never furnish quartz enough to supply even the existing pebbles; and the extinct pebbles—those ground down to sand—must have been even more than those now surviving. If we break up all the quartz-ledges at present existing in the South Mountains, and eke them out with the quartz-veins penetrating like threads the mass of the other strata, these, when rounded into pebbles, will sink into utter insignificance beside the mountain which would rise were all the remaining quartz-pebbles of the Pennsylvanian Conglomerates collected into one place and piled together.

In conclusion, then, it follows from the facts here put forward, whether the figures given be exact or not, that an almost incredible amount of material was eroded from the archæan land of North America during palæozoic days. In no other way can we account for the enormous palæozoic deposits of the Eastern and Midland States. Yet it is not probable that the land ever stood at any dizzy height above the sea. The slow secular depression of which we have so abundant evidence from every part of the globe, and which in this very region has carried Middle Pennsylvania down at least thirty thousand or forty thousand feet below its former level, is quite sufficient to account for the

phenomena. Let but the sea-margin, which was the loaded area, sink somewhat faster than the dry land, which was the lightened area, and we have all the conditions that were needed for the erosion and denudation of the relatively rising surface to any required amount. The only limit is some physical change which could put a stop to the rising of the one or the sinking of the other, and this came at the end of palæozoic time, when the Appalachian trough became full.

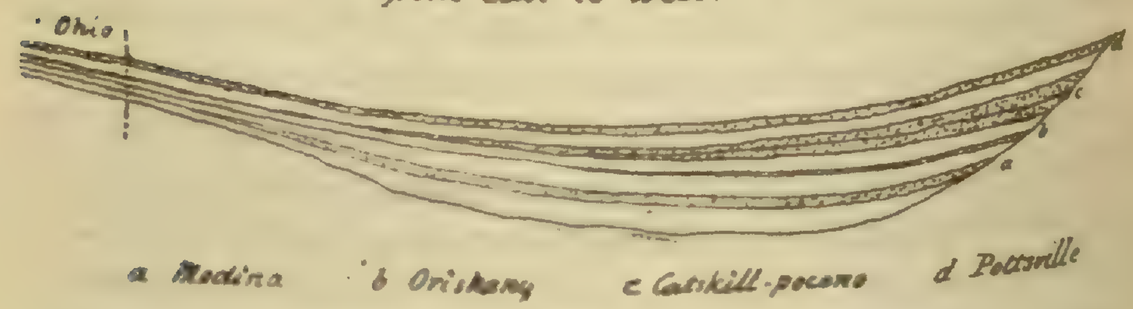
Another conclusion may be drawn from the facts stated in the second part of this paper. I have pointed out the enormous quantity of white vitreous quartz-pebbles that lie in the palæozoic sandstones of Pennsylvania, and have shown that their only possible known source is the quartz-ledges of the South Mountains. I have also shown that this source is very small when we consider the total mass of the pebbles. It follows, therefore, that at the time when these pebbles were made—that is, during the palæozoic era—there must have been a larger supply of white quartz to afford their material. In other words, the pre-palæozoic rocks, with their quartz-ledges, must have been much more extensive then than they are now. The narrow strip along the South Mountains and their continuation in Pennsylvania, New Jersey, and Maryland, so far as the present subject is concerned, can scarcely exceed one thousand square miles in area. It is hard to avoid the inference that vast masses of ancient strata have totally disappeared from this region. Possibly such masses existed, overlying more or less of the archæan area in the southeast. If so we have at the same time a sufficient quarry from which the rains and waves of that age could obtain their material and a body of rock hard and thick enough to keep them employed during those millions of years.

Any attempt to discuss further the place and extent of this land-surface must be reserved for another time. It may have overlain more or less of the soft gneiss-rocks of Pennsylvania and have been since removed. It may have been crumpled into anticlinal folds with the gneiss, as are now the palæozoic rocks; or it may to a greater or less extent have been contracted in area by the tremendous lateral compressing force to which this region has been subjected. Or, again, one portion to the east may have been shoved over on another to the west, as has happened, we now find, in other parts of the State and in other places in the world. All

this must be left for further investigation. My purpose in this paper has been to show that the sandstone beds of Middle and Western Pennsylvania imply the past existence of quartz-rocks more extensive by far than their present remains would indicate, and that the white pebbles of these Conglomerates imply an immense extension of the ledges of milky quartz that are now to be seen in the rocks of the South Mountains.

In the map and section accompanying this paper an attempt is made to represent to the eye the leading facts in the argument. It is of course quite impossible to draw the latter to scale, nor would any useful purpose be served by the attempt. The uncolored portions show the soft beds lying between the sandstones, which are really in most cases thicker than the sandstones themselves. The only points which the section is intended to bring out are the profound Appalachian trough in which the palæozoic sediments were deposited, the westward thinning of all, both sandstones and shales, and the fining of the Conglomerates in the same direction.

Diagrammatic Section of Pennsylvania from East to West.



(To be concluded.)

THE PROGRESS OF ARACHNOLOGY IN AMERICA.

BY LUCIEN M. UNDERWOOD, PH.D.

NOTWITHSTANDING all that is said and written to the contrary, the student of entomology still continues to do miscellaneous work in the "description of new and little known species;" and so long as this miscellaneous fever continues, so long must some one periodically gather up the fragments, in order to save future species-makers the trouble of re-describing what has already been fully described. In these days of such multiplicity of periodical literature it is difficult for the aspiring student—many times far away from the friendly counsel of some one wiser than himself, and away from the larger libraries that would supply many deficiencies—to know what others have already written on any particular family, and where the scattered literature may be found, in order that he may have a substantial basis on which to work. However a worker may modify his views later in life in regard to the proper methods and subjects for investigation, he will invariably develop his *enthusiasm*, if he have any, in a systematic study of some life-group in which his first ambition is to *name* the species of his collection. He may afterwards leave his first love as his mature views cause him to recognize the greater importance of morphological and embryological work, but he will rarely, if ever, commence his entomological career in any other way. Here our leaders in entomology may well take a suggestion, for at the early stages of systematic study too many young persons become hopelessly discouraged who might with proper encouragement become enthusiastic workers. Finding no accessible elementary aids to study, and finding such aids as do exist scattered through volume after volume of "Transactions" never found in their town or college library, they abandon a field in which they might make valuable additions to science for one whose entering pathway seems less beset with difficulties,—*i.e.*, they leave the study of entomology entirely.

Notwithstanding the many valuable papers that have appeared in recent years on our American Hymenoptera, we venture to predict that none of them will do so much to stimulate the study of this most interesting group of insects as Mr. Cresson's

"Synopsis of Families and Genera," which the author too modestly styles a "compilation." The reason is obvious; and those who desire to stimulate the beginner must proceed with eyes open, and bear the necessities of the case in mind.

It has been customary in many groups to publish periodical check-lists, which may possibly serve some useful purpose, but as a rule they are scarcely of a value equal to the labor bestowed upon them, since a little additional labor and a small increase of volume would make of a mere list of names a valuable index to the literature of an order and an outline of its known geographical distribution.

The literature pertaining to the American species of Arachnida, like that on most zoological groups, is exceedingly scattered, and up to the present time no *résumé* has been prepared that will at once place the student in the possession of the always welcome information regarding the present status of the subject.

The first recorded observations on the spiders of the North American fauna were by Lewis Bosc and Thomas Abbot, neither of which reached publication. Bosc left manuscript notes, together with colored drawings of twenty-five Carolina spiders, entitled "Sur les Araignées de la Caroline." The names of his species were published by Baron Walckenaer in 1805, but the descriptions did not appear until the publication of the first two volumes of "Apteres," in 1837. Thomas Abbot, better known by his work on the Lepidoptera, prepared an extensive series of illustrations of Georgian spiders, accompanied by manuscript "Notes and Observations on the Drawings of the Spiders of Georgia." Knowledge of the date of preparation of this series of drawings, as well as of its present place and condition of preservation, is wanting, but it was in London as early as 1802, and was purchased by Baron Walckenaer in 1821. Of the five hundred and thirty-five figures only three hundred could be classified with any certainty by Walckenaer, and the descriptions were published by him in his "Apteres." Very few of these species have been identified in recent times, owing largely, no doubt, to the fact that these southern tramping-grounds of the pioneers of American entomology have never been explored by recent investigators. As many of the species are based on color, which among spiders is exceedingly variable, rather than on more constant structural characters, there are doubtless

many synonymes among them, if, indeed, they can ever be fully identified.

The writings of these pioneers were unknown to Say, who published in 1821 a paper on the lower Arachnida, describing twenty-four species of *Acarina* and eight species of *Arthrogastra*. As we have already published elsewhere bibliographic lists of these two groups,[1] we shall confine the account here given of the literature to the true spiders (*Araneæ*).

The work of Baron Walckenaer has been mentioned already in connection with that of Bosc and Abbot. In the first two volumes of "Apteres" he described two hundred and forty-four North American species, of which two hundred and twenty-six were from Georgia and Carolina. Of these, one hundred and seventy, over two-thirds, are distributed among the four genera,—*Lycosa*, twenty; *Attus*, sixty-six; *Thomisus*, twenty-seven; and *Epeira*, fifty-seven.

Nicholas Hentz began his study of the spiders of the Southern States in 1821, and his publications in the Journal of the Boston Society of Natural History from 1842 to 1850 form the basis of the study of arachnology in this country. These papers, with others by the same author, have since been reprinted in the "Occasional Papers" of the Boston Society (1875). Hentz described two hundred and fifty species, of which one hundred and ninety-nine, or four-fifths, were from the Southern States, chiefly North Carolina and Alabama, where he resided for a long time. Of these, one hundred and fifty have not yet been identified by recent investigators. Add to this number those described by Walckenaer, and we have from the Southern States alone a total of three hundred and seventy-five species of spiders which stand as mere names on our lists, with no specimens anywhere to represent them! As Hentz nowhere mentions Walckenaer's "Apteres," it is more than probable that he was

[1] Preliminary List of the Arthrogastra of North America north of Mexico, in Canadian Entomologist, xvii. 162–169 (September, 1885), and Preliminary List of the Species of Acarina of North America, in Canadian Entomologist, xviii. 4–12 (January, 1886). There are as yet no additions to make to the former, except to note that *Gonyleptes ornatum* Wood has been set aside as a species distinct from *Cynorta ornata* (Say) under the name of *Cynorta sayii* Simon. When the latter list was published, the work of Hallier and J. B. Tyrrell on the Acarina parasitic on birds was unknown to both Professor Osborn and myself. A few species have been since described. These will appear shortly in a supplementary list.

not familiar with it, and that he redescribed some, if not many of Walckenaer's species.

Nothing more appeared until 1854, when Charles Girard published descriptions of *Mygale hentzii* and *Lycosa pilosa*, collected on Marcy's Red River expedition. The former is the "tarantula" of the Southwest, so commonly found in collections.

Ten years later (1864) Count Keyserling commenced a series of papers, largely on American spiders, which have resulted in some of the most extensive monographs that have appeared on the spiders of this or any land. The first two papers (1864–65) were on the Epeiridæ, or round-web spiders; later have appeared eight shorter papers, the last six (1879–84) forming a series entitled "Neue Spinnen aus Amerika." Most important of all, however, are his elegant quartos, "Die Spinnen Amerikas," of which two volumes have already appeared. The first, on the Thomisidæ, or laterigrade spiders, appeared in 1880, and describes three hundred and fifteen species, of which one hundred and eighteen are new. These are from all America, South as well as North. The second volume, on the Theridiidæ, appeared in two parts (1884 and 1886), and describes three hundred and twenty-five species, of which two hundred and thirty-eight are new. One hundred and thirty-five, including seventy-five new species, are from North America; the remainder are from South America.

In 1869, Giebel described six species of spiders from Illinois, of which four were new. Two years later (1871) Anton Ausserer published extensive notes on the Mygalidæ, or trap-door spiders, of which a considerable number were from America. He gave a revision of the genera, which is now largely followed. In 1875 he published a supplementary paper on the same subject.

In the same year also appeared a paper by John Blackwall on spiders from Canada, describing five new species from the vicinity of Montreal.

Rev. O. P. Cambridge, the well-known author of "The Spiders of Dorset," published in 1874 and 1875 two short papers "On some New Species of Erigone from North America," and in 1881 a paper on "Newfoundland Spiders." In 1874, J. H. Emerton, who has done more in recent times than any other American to bring to light new forms of our spider fauna, commenced publication of the results of his studies. One of his

first efforts was the editing, with valuable supplementary notes, of Hentz's writings, above mentioned. He afterwards (1875) published sundry notes in the AMERICAN NATURALIST on the cave spiders of Virginia, and described two species from Colorado as an appendix to one of Thorell's papers. In 1878 he published a popular elementary work on the "Structure and Habits of Spiders." This was largely used in the preparation of articles which were printed in the Report of the Entomological Society of Ontario for 1879, and in the "Standard Natural History." In 1882 he commenced a series of papers on the spiders of New England, and has already given us valuable monographs of the families Therididæ (1882), Epeiridæ (1884), and Lycosidæ (1885). He has in course of preparation papers on the other families of the same region. In these three papers he has described one hundred and seventeen new species, divided among the three families as follows: Therididæ, eighty-five; Epeiridæ, twelve; and Lycosidæ, twenty. This unusually large number results from the fact that previous workers had described species largely from the Southern States.

In 1875, Dr. Thorell, well known by his various works on European spiders as well as by various papers on the scorpions and opiliones, published a short "Notice of Some Spiders from Labrador," in which he described seven new species. Two years later (1877) he published a second paper, on the "Aranea collected in Colorado in 1875 by A. S. Packard;" twenty-six species are described as new; this is almost the only paper that has yet appeared on the spiders of the region west of the Mississippi River.

Rev. H. C. McCook has published, in the Proceedings of the Philadelphia Academy (1876–83), a series of interesting papers on the habits of some of the web-building spiders; these include also the descriptions of some new species.

S. H. Scudder, in 1877, and Dr. George Marx, in 1881, described new species of Lycosidæ, with accounts of their nest-building habits.

In 1883 the Peckhams, of Milwaukee, commenced the publication of new species of Attidæ, or jumping spiders; twenty-five species are described, of which twenty-one are new.

Lastly, in 1886, Professor Atkinson, of Chapel Hill, N. C., in three papers, has described some new Mygalidæ, or trap-door

spiders, from that region; many interesting notes of habits and nests are also given. A few other short papers will be referred to in the classified list of literature given below.

The above descriptive and systematic works describe from the region north of Mexico nine hundred and thirty-five species included in one hundred and thirty-seven genera. (This, of course, excludes those species which have been already reduced to synonymes.) They are distributed in families as follows:

	Genera.	Species.
THERIDIDÆ	44	268
EPEIRIDÆ	16	172
THOMISIDÆ	14	107
ATTIDÆ	12	156
LYCOSIDÆ	9	119
DRASSIDÆ	9	55
MYGALIDÆ	12	23
SPARASSIDÆ	4	7
DYSDERIDÆ	3	5
DICTYNIDÆ	2	6
AGALENIDÆ	2	3
ULOBORIDÆ	2	3
PHOLCIDÆ	2	2
SCYTODIDÆ	1	1
Of uncertain relations	5	8
Totals	137	935[1]

Of course, the above numbers may be somewhat reduced, as a study of Southern forms will cause an identification of Walckenaer's species with those of Hentz, with the usual harvest of synonymes.

So far as is known to us, only five persons are actively engaged in the study of the Arachnida in America.[2] J. H. Emerton is continuing his study of the spider fauna of New England: Professor Atkinson is at work on the Mygalidæ; the Peckhams are studying the Attidæ; and Dr. Marx, of Washington, will soon give us a revision of the scorpions. In Europe, Count Keyserling is continuing his researches, and will doubtless add

[1] If we add to these the two other principal groups of Arachnida as already catalogued, we have:

	Families.	Genera.	Species.
ARANEÆ	14	137	935
ARTHROGASTRA	7	20	59
ACARINA	7	36	121
Totals	28	193	1114

[2] Since the above was written, we learn that Dr. McCook is preparing for the press an extensive work on the spinning habits of American spiders.

much to his already extensive contributions. It would seem that so interesting a group would attract a wider range of students, not only in systematic work, but in the investigation of the deeper and more fundamental questions of morphology and embryology, which offer a field almost wholly unexplored, full of questions waiting to be settled by careful extended study.[1]

In the study of geographical distribution other interesting questions offer themselves. Besides the problem of the spiders of the South above alluded to, which ought to demand immediate attention from some one, the great interior is almost wholly unexplored in reference to its spider fauna; Thorell's few species from Colorado and a few others described by Keyserling represent the condition of our knowledge of this region. From the Pacific coast comes a more pressing need for study, as scarcely a score of species have been described from California.[2]

As among many groups of life forms, both plant and animal, there is greater need of revision of families than there is of the miscellaneous and often hurried description, here and there, of a few "species supposed to be new" by some one only partly familiar with the literature of the subject. We can better afford to wait five or ten years for a monograph of a family prepared by some one who has thoroughly studied and compared the American species, than at the end of the same period to be obliged to search hither and yon for descriptions written by

[1] We would not neglect to mention in this connection the valuable paper by Mr. William A. Locy: "Observations on the Development of *Agelena nævia*," published by the Museum of Comparative Zoology at Cambridge.

[2] If we compare the distribution of a single family, the Epeiridæ, as now known from the various parts of America, it will probably serve as a type of the distribution of the entire group of the Arachnida. Of the one hundred and seventy-two described American Epeiridæ we have:

Of general distribution (at least east of Sierras)	2
Generally distributed east of the Mississippi	25
Confined to Northern States	25
Confined to Southern States (south of Virginia)	93
(This includes seventy-one of Walckenaer's species and fourteen of Hentz's not recently identified.)	
From New England (exclusively)	17
From Mississippi Valley (north)	4
From Rocky Mountain Region (Colorado and Utah)	3
From California	2
From Texas	1

Compared with these figures Simon described seventy-three species in "Les Arachnides de France" and Westring thirty-four species in "Araneæ Suecicæ."

various persons, whose over-anxiety for fame could not resist giving premature birth to "sundry new species."

Meanwhile, well-constructed synopses that represent careful comparisons and will serve as a thorough index to what is known of a subject are not out of place, and will greatly assist beginners in their study. In this matter our American arachnologists may well pattern after the elegant models set them by Simon and Keyserling, in placing a carefully prepared synoptic table of genera and species at the head of each article. A descriptive work without such a synopsis is as faulty as a work of reference without an index or a library without a card catalogue.

In order to render this paper practical for students who desire to enter this attractive group of animal life, we present, first, a synoptic table of families, translated from Simon's admirable "Les Arachnides de France," followed by a summary of the literature of the American species:

ARANEÆ.

SYNOPSIS OF FAMILIES.[1]

A.—Copulatory organ of the ♂ enveloped by the tarsal article of the maliped,[2] which is hollowed in the form of a cupule, or, at least, much enlarged; ♀ with an epigyne[3].....B

Copulatory organ of the ♂ inserted under the tarsal article [of the maliped], without modifying its form; ♀ without an epigyne.....S

B.—Eyes equal or sub-equal, often dissimilar,[4] forming a transverse group wider than deep on the anterior portion of the cephalothorax (sub-order, **Ar. veræ**.....T

Eyes unequal, always similar, occupying the entire length of the head, and forming a group as deep or deeper than wide (sub-order, **Ar. oculatæ**.....C

[1] Before an attempt is made to use this table, the reader may, with profit, study the structure of the large spider which commonly builds its nest in the form of a tube with spreading mouth about houses and in the grass. The males will be readily distinguished by their enlarged "palpi." The female reproductive organs will be found at the base of the abdomen below. This spider is the *Agelena naevia*, belonging to the first family under "R."

[2] The *patte-mâchoire* of Simon is, perhaps, best called *maliped*; it is the "palpus" of most American writers.

[3] The *epigyne* represents the whole of the external generative organs of the ♀. In its fundamental form it consists of two sacs, which connect by two little tubes with the oviduct near its mouth, and by two larger tubes with the outside of the spider. *Cf.* Emerton, "Structure and Habits of Spiders."

[4] This refers both to structure and function; two sorts of eyes are found in certain spiders,—(1) convex, round, colored eyes, adapted to diurnal vision, and (2) flat, uncolored eyes of various shapes, adapted to nocturnal vision.

C.—Cephalothorax raised, prismatic; face triangular.....D
Cephalothorax truncate anteriorly; face quadrate; eyes in three rows (4, 2, 2).....**Attidæ.**[1]
D.—Eyes placed in four rows (2, 2, 2, 2).....**Oxyopidæ.**[2]
Eyes placed in three rows (4, 2, 2).....**Lycosidæ.**
E.—Tarsi with three claws.....I
Tarsi with two claws.....F
F.—With three pairs of spinnerets.....G
With only one pair of spinnerets.....PALPIMANIDÆ.
G.—All the eyes similar, diurnal; second pair of legs longer than the fourth, and often than the first.....H
Anterior median eyes diurnal, all the others nocturnal; second pair of legs longer than either the first or fourth.....**Drassidæ.**
H.—Maxillary lamellæ[3] straight; fillet[4] very narrow.....**Sparassidæ.**
Maxillary lamellæ inclined much beneath the anterior portion of the sternum; fillet large.....**Thomisidæ.**
I.—♀ with a calamistrum[5] and a cribellum.....K
♀ with neither calamistrum nor cribellum.....M
K.—Eyes dissimilar, equidistant, forming two parallel lines.....**Dictynidæ.**
Eyes similar, the lateral (at least the posterior) much removed from the median L
L.—Cephalic portion very convex, strongly separated from the thoracic portion; median eyes unequal, forming a compact group, separated from the lateral by two lines.....ERESIDÆ.
Cephalic portion flat, indistinct; median eyes equal, little removed from the lateral of the first row.....**Uloboridæ.**[6]
M.—Tarsi provided with a third article (onychium)[7].....N
Tarsi formed of only two articles.....P
N.—With two pairs of spinnerets, the lower more developed.....ENYOIDÆ.
With three pairs of spinnerets.....O
O.—Spinnerets equal, arranged in a rosette, all of a single article.....**Pholcidæ.**[8]
The upper [spinneret] much longer, formed of two or three articles..HERSILIDÆ.
P.—Fillet as wide or wider than the ocular area.....Q
Fillet narrower than the ocular area.....R
Q.—Cephalothorax oval, elongate, the cephalic portion narrow, raised; spinnerets equal, all formed of a single article.....**Theridiidæ.**
Cephalothorax short, rounded or reniform, the cephalic portion not narrowed; upper spinneret long, of two articles.....UROCTEIDÆ.

[1] Families known to be represented in the United States are in bold-face type, others in small capitals.

[2] This is placed by American writers with the Lycosidæ.

[3] The *maxillary lamellæ* are enlargements of the coxal articles of the malipeds.

[4] The *fillet* is the space between the eyes and the base of the mandibles (*cheliceres.*)

[5] The *calamistrum* is a comb of stiff hairs on the penultimate joint of the fourth leg. The *cribellum* is an additional spinning organ covered with fine tubes and placed in front of the spinnerets.

[6] Emerton, following Blackwall, places the species of this family in the Cribellatidæ.

[7] The legs in most spiders are formed of seven articles; the onychium, which appears in three families, forms an eighth.

[8] Emerton unites this family with the Theridiidæ.

R.—Median anterior eyes diurnal, all the others nocturnal; ♂ genital article cup-shaped, covering the copulatory organ; epigyne of ♀ in the form of a plate.....**Agelenidæ.**

Eyes (or, at least, the four anterior) all diurnal; ♂ genital article laciniate, encompassing the copulatory organ; epigyne of ♀ provided with a hook or finger.....**Epeiridæ.**

S.—Mandibles (*cheliceres*) inserted vertically, their second articles bending under the internal side; eyes 6, nocturnal (sub-order, **Ar. gnaphosæ**).....T

Mandibles inserted horizontally, their second articles bending longitudinally downward; eyes 8, of which two are diurnal (sub-order, **Ar. theraphosæ**[2]).....U

T.—Eyes forming a compact group.....**Dysderidæ.**

Eyes disposed in three separate groups.....**Scytodidæ**[1]

U.—With a single pair of epigastric stigmata; ♀ with a calamistrum..FILISTATIDÆ.

With two pairs of epigastric stigmata; no calamistrum.....**Aviculariidæ**[2]

The following is a classified arrangement of the principal literature on American spiders, which will summarize what has been somewhat briefly reviewed above. A few of the most important European works are added, as they contain much of general value on the subject:

I. GENERAL.

BARON WALCKENAER.—Histoire Naturelle des Insectes,—Apteres. Tome i. et ii., on Araneina (1837).

N. M. HENTZ.—Descriptions and Figures of the Araneides of the United States; in *Jour. Boston Soc. Nat. Hist.*, iv. 54–57, 223–231, 386–396 (1842–44); v. 189–202, 352–369, 444–478 (1845–47); vi. 18–35, 271–295 (1850). Reprinted with other papers in one volume,—The Spiders of the United States. 8vo. Boston (1875).

CHARLES GIRARD.—Arachnidians; in App. F to Marcy's "Report of Red River Expedition," 233–235 (1854).

C. G. GIEBEL.—Ueber einige Spinnen aus Illinois; in *Zeitschrift für die Gesamm. Naturwissensch.*, 1869, 248–253.

JOHN BLACKWALL.—Notice of Spiders captured by Miss Hunter in Montreal, Upper Canada, with descriptions of species supposed to be new to arachnologists; in *Annals and Mag. of Nat. Hist.* (fourth series), viii. 429–436 (1871).

T. THORELL.—Notice of some Spiders from Labrador; in *Proc. Boston Soc. Nat. Hist.*, xvii. 490–504 (1875).

——Araneæ collected in Colorado in 1875 by A. S. Packard, Jr., M.D.; in *Bull. U. S. Geol. Survey* (Hayden), iii. 477–529 (1877).

J. H. EMERTON.—Cave Spiders from Virginia; in *American Naturalist*, ix. (1875)

——Spiders Common to New England and Europe; in *Psyche*, i. 129–131 (1876)

——Structure and Habits of Spiders. 12mo. Salem (1878). Copious abstracts of this popular work appear in the "Annual Report of the Entomological Society of Ontario" for 1879, and in vol. ii. of the "Standard Natural History."

[1] Emerton unites this family with the Theridiidæ.

[2] More commonly known in this country as the Mygalidæ, or trap-door spiders.

Graf. Eugene Keyserling.—Amerikanische Spinnenarten aus den Familien Pholcoidæ, Scytodoidæ und Dysderoidæ; in *Verhandl. d. k. k. zool.-bot. Gesellschaft*, xxvii. 205–234 (1877).

——Neue Spinnen aus Amerika, vi. Theile; in *Verhandl. d. k. k. zool.-bot. Gesellschaft*, xxix. 293–350 (1879); xxx. 547–582 (1880); xxxi. 269–314 (1881); xxxii. 195–229 (1882); xxxiii. 649–684 (1883); xxxiv. 489–534 (1884).

O. P. Cambridge.—Newfoundland Spiders; in *Proc. Royal Physical Soc. Edinb.*, 1881.

II. EUROPEAN.

E. Simon.—Les Arachnides de France, tome i.–v. Paris (1874–84).

O. P. Cambridge.—The Spiders of Dorset; with appendix, containing descriptions of those spiders not yet found in Dorsetshire. 2 vols. Sherborne (1879–81).

T. Thorell.—On European Spiders. Part I.—Review of the European Genera of Spiders. Upsaliæ (1869–70).

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A. Menge.—Preussische Spinnen. Danzig (1866–79).

L. Becker.—Les Arachnides de Belgique. Bruxelles (1882).

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III. SPECIAL LITERATURE ON LEADING FAMILIES.[1]

A. EPEIRIDÆ.

Graf. E. Keyserling.—Beschreibungen neuer und wenig bekannter Arten aus der Familie Orbitelæ Latr. oder Epeiridæ Sund.; in *Sitzungsber. des Isis zu Dresden*, 1863, 63–154 (1864).

——Beiträge zur Kenntniss der Orbitelæ Latr.; in *Verhandl. d. k. k. zool.-bot. Gesellschaft*, xv. 799–856 (1865).

J. H. Emerton.—New England Spiders of the Family *Epeiridæ*; in *Trans. Conn. Acad.*, vi. 295–342 (1884).

B. G. Wilder.—[Notes on *Nephila plumipes*] in *Proc. Boston Soc. Nat. Hist.*, x. 200–210 (1865).

H. C. McCook.—On Webs of New Species of Spiders (verbal communication); in *Proc. Phila. Acad.*, 1876, 200, 201.

——The Basilica Spider and her Snare; in *Proc. Phila. Acad.*, 1878, 124–135.

——The Snare of the Ray Spider (*Epeira radiosa*),—A New Form of Orb-Web; in *Proc. Phila. Acad.*, 1881, 163–175.

——How Orb-Weaving Spiders make the Frame-work or Foundation of Webs; in *Proc. Phila. Acad.*, 1881, 430–435.

——Snares of Orb-Weaving Spiders; in *Proc. Phila. Acad.*, 1882, 254–257.

George Marx.—Description of *Gasteracantha rufospinosa*; in *Entomologica Americana*, ii. 25, 26 (1886).

See also *Simon*, Les Arachnides de France, tome i.

B. THERIDIDÆ.

Graf. E. Keyserling.—Die Spinnen Amerikas. II. Theridiidæ. 1 Hälfte, Nürnberg (1884). 2 Hälfte, Nürnberg (1886).

[1] Besides the following special papers on each of these families, many species are described in most of the general papers above named, which it is not necessary to repeat here.

O. P. CAMBRIDGE.—On some New Species of *Erigone* from North America 2 parts; in *Proc. Zool. Soc. London.* 1874, 428–442; 1875, 393–405.

J. H. EMERTON.—New England Spiders of the Family *Theridiidæ;* in *Trans. Conn. Acad.*, vi. 1–86 (1882).

See also *Simon*, Les Arachnides de France, tome v.

C. THOMISIDÆ.

GRAF. E. KEYSERLING.—Die Spinnen Amerikas. Laterigradæ. 4to, pp. 283. Nürnberg (1880).

H. C. MCCOOK.—Note on the probable Geographical Distribution of a Spider by the Trade Winds; in *Proc. Phila. Acad.*, 1878, 136–147.

See also *Simon*, Les Arachnides de France, tome ii.

D. ATTIDÆ.

G. W. and E. G. PECKHAM.—Descriptions of New or Little-Known Spiders of the Family Attidæ from various parts of the United States of North America. Pp. 36. Milwaukee (1883).

H. C. MCCOOK.—Note on Two New California Spiders and their Nests (verbal communication); in *Proc. Phila. Acad.*, 1883, 276–278.

See also *Simon*, Les Arachnides de France, tome iii.

E. DRASSIDÆ.

C. L. KOCH.—Die Arachniden Familie der Drassiden. Nürnberg (1866–68).

O. P. CAMBRIDGE.—On some New Species of Drassides; in *Proc. Zool. Soc. London*, 1874, 370–419.

See also *Simon*, Les Arachnides de France, tome iv.

F. LYCOSIDÆ.

GRAF. E. KEYSERLING.—Ueber Amerikanische Spinnen Arten der Unterordnung Citigradæ; in *Verhandl. d. k. k. zool.-bot. Gesellschaft*, xxvi. 609–708 (1876).

J. H. EMERTON.—The Lycosa at Home; in *American Naturalist*, iv. 664, 65 (1870).

——New England Spiders of the Family *Lycosidæ;* in *Trans. Conn. Acad.*, vi. 481–505 (1885).

S. H. SCUDDER.—The Tube-Constructing Ground-Spider of Nantucket; in *Psyche*, ii. 2–9 (1877).

GEORGE MARX.—On some New Tube-Constructing Spiders; in *American Naturalist*, xv. 396–400 (1881).

H. C. MCCOOK.—Note on the Intelligence of the American Turret-Spider (verbal communication); in *Proc. Phila. Acad.*, 1883, 131, 132.

See also *Simon*, Les Arachnides de France, tome iii.

G. MYGALIDÆ.

S. B. BUCKLEY.—The Tarantula and its Destroyer; in *Proc. Amer. Entom. Soc.*, i. 138, 139 (1862).

ANTON AUSSERER.—Beiträge zur Kenntniss der Arachniden Familie der Territelariæ Thorell; in *Verhandl. d. k. k. zool.-bot. Gesellschaft*, xxi. 117–224 (1871).

——Zweiter Beitrag zur Kenntniss der Arachniden Familie der Territelariæ Thorell. *Ibid.*, xxv. 125–206 (1875).

J. T. MOGGRIDGE.—Harvesting Ants and Trap-Door Spiders; with Supplementary Descriptions of Species by Rev. O. P. Cambridge. London (1873–74).

H. C. MCCOOK.—Restoration of Limbs in Tarantula; in *Proc. Phila. Acad.* 1883, 196, 197.

GEORGE F. ATKINSON.—A New Trap-Door Spider; in *American Naturalist*, xx. 583–593 (1886).

——A Family of Young Trap-Door Spiders; in *Entomologica Americana*, ii. 87–92 (1886).

——Descriptions of some New Trap-Door Spiders, their Notes (*sic*) and Habits; in *Entomologica Americana*, ii. 109–117, 128–137 (1886).

SYRACUSE UNIVERSITY, August, 1887.

HISTORY OF GARDEN VEGETABLES.

BY E. LEWIS STURTEVANT, A.M., M.D.[1]

(Continued from page 912.)

EGG-PLANT. *Solanum melongena* L.

THE egg-plant seems not to have been known in Europe in the time of the ancients. The Arab physician, Ebn Baithar, who wrote in the thirteenth century, speaks of it, and cites Rhases, who lived in the ninth century.[2] Albertus Magnus,[3] who lived in Europe in the thirteenth century, mentions it,—"Et sic inveninutur tres sapores in melangena, amarus acutus et stypticus." Ibn-al-awan, a Moorish Spaniard of the twelfth century, describes four species, and the Nabatheenne agriculture six.[4] According to Jessen,[5] Avicenna, who flourished about A.D. 595, knew it, and called it Badingan. This latter word, variously spelled, is the present name in Hindustanee, Arabic, Persian, and Sumatran,[6] and the closely corresponding English[7] name in India is Brinjal, and Begoon;[8] in Spain, Berengena; or at San Domingo, Beringene.[9] Bretschneider[10] says the egg-plant can be identified in the "Ts'i min yao shu," a Chinese work on

[1] Director of the New York Agricultural Experiment Station, Geneva.
[2] De Candolle, Orig. des Pl. Cult., 229.
[3] Albertus Magnus, De Veg., Jessen ed., 1867, 204.
[4] Ibn-al-awan, Le Livre d'Agriculture. Trans. of Clement-Mullet, 1886, ii. pt. 1, pp. 236–239.
[5] Albertus Magnus, l. c., note.
[6] Birdwood, Veg. Prod. of Bombay, 173.
[7] Drury, Useful Pl. of Ind., 410.
[8] Firminger, Gard. in Ind., 155.
[9] Heuze, l. c., ii. 695.
[10] Bretschneider, Bot. Sin., 59.

agriculture of the fifth century, and is described in later writings of 1590, 1640, and 1742. Acosta[1] mentions, as among the vegetables carried from Spain to America, the "Becengenes, or apples of Love;" and Piso,[2] in 1658, figures the egg-plant among Brazilian plants, under the name of Belingela.

The various European names are given as below: in Belgian, *veramgenes*, *eierplant;* in English, *apples of love*, *madde apples*, *egg-plant;* in France, *albergine*, *avbergine*, *beringene*, *brehheme*, *bringele*, *magrinan*, *mayenne*, *melanzane*, *merangene*, *meringeane*, *verinjeane*, *viadase;* in Germany, *Eierpflanze;* in Italy, *petonciano*, *melanzacca*, *maringiani;* in Portugal, *bringela;* in Spain, *berengena*.[3]

These names are largely derived from the Arabic *melongena*,[4] as given by Rauwolf.

The egg-plants first known in Europe appear to belong to the class we now grow for ornament, and the fruit resembling an egg. They were of various colors. Fuchsius (1542) mentions the purple and the yellow; Tragus (1552), who says they have recently reached Germany from Naples, names the same colors; Lyte's "Dodoens" (1586) reads two kinds,—one purple and the other pale or whitish. In 1587, Dalechamp figures three kinds, —the one long, another obscurely pear-shaped, and the third rounded,—and mentions the colors purple, yellow, and ash-colored; Gerarde (1597) says white, yellow, or brown; Dodonæus (1616) mentions the oblong and round, white and purple; Marcgrav, in 1648, describes a round and yellow fruit; J. Bauhin (1651) names various sorts,—the long, the deep, and the round, yellow, purple, and whitish. Bontius, in 1658, describes the wild plant of Java as oblong and round, or spherical, the color yellow; the cultivated sorts purple or white, etc. Rauwolf, who particularly described these plants at Aleppo in 1574, as ash-colored, yellow, and purple.

At present the purple egg-plant is almost the only color grown in our kitchen-gardens, but there are many sorts grown in other regions. The purple and the white ornamental are named for American gardens in 1806, as also in England in 1807, in France in 1824, etc. In the Mauritius, Bojer[5] names

[1] Acosta, Hist. of the Ind., Eng. ed., 1604, 294.
[2] Piso, De Ind. Utrinsque, 1658, 210.
[3] Vilmorin, Les Pl. Pot., 23.
[4] Rauwolf, Ex Bauh., Phytopin., 1596, 300.
[5] Bojer, Hort. Maurit., 240.

three varieties, and the purple and white colors. In India, Carey[1] says, there are several varieties in constant cultivation by the natives, such as green, white, purple, yellow, etc. Firminger[2] describes purple-, black-, and white-fruited forms; and Speede[3] names the purple and white in six varieties. In Cochin China, Loureiro describes five sorts, purple, white, and variegated.

There are two sorts of plants to be recognized,—(*a*) the one with the stems, leaves, and calyxes unarmed, or nearly so; (*b*) the other with the stems, leaves, and calyxes more or less aculeate.

a. The first sort is figured by Fuchsius (1542), and by succeeding authors up to the present date.

b. The second sort is first noticed, so far as I can ascertain, by Camerarius in 1588, and has continued to the present time.

The varieties now grown in American gardens can be divided very readily into four types,—the oval, the round, the long, and the oblong or pear-shape,—and the following synonymy can be established:

I. The *Oval.* This, at present, includes but ornamental sorts, and our present forms show a marked improvement in evenness and regularity over the older forms.

a. Calyx not Spiny.

Mala insana. Fuch., 1542, 513; Roszlin, 1550, 117; Tragus, 1552, 894; Pinæus, 1561, 514; Ger., 1597, 274; Swertius, 1612, t. 20, p. 1; Dod., 1616, 458.

Melangena sive mala insana vel melanzana. Lob. Obs., 1576, 138; *ic.*, 1591, i. 268.

Melongena, seu mala insana. Cam., Epit., 1586, 820.

Melongena. Matth., Opera., 1598, 760.

Melanzane. Cast. Dur., 1617, 279.

Solanum pomiferum fructu rotundo. J. Bauh., 1651, iii. 618.

Melongena arabum. Chabr., 1673, 524.

Aubergine blanche. Vilm., 1883, 27.

b. Calyx Spiny.

Melanzana fructu pallido. Hort. Eyst., 1713; Aut. Ord., i. p. 3; also *ib.*, 1613.

White Egg-Plant. N. Y. Sta., 1886.

II. The *Round.*

[1] Carey, Hort. Beng., 16.

[2] Firminger, Gard. in India, 155.

[3] Speede, Indian Handb. of Gard., 177.

a. CALYX NOT SPINY.

Belingela. Marcg., 1648, 24; Piso, 1658, 210.
Aubergine ronde de Chine. Decaisne & Naudin, Man., iv. 288.
Black Pekin. Ferry, 1883; Hovey, 1866.

b. CALYX SPINY.

Black Pekin. Greg., 1886; Thorb., 1886.

III. The *Long*. This varies much in size and proportion,—if the Chinese variety described by Kizo Tamari[1] as recently introduced into Japan belongs to this class. He says it is about one inch in diameter by one foot and a half long. This form may be either straight or curved.

a. CALYX NOT SPINY.

Melantzana arabum melongena. Lugd., 1587, ii., app., 23.
Solanum pomiferum fructu incurvo. J. Bauhin, 1651, iii. 619; Chabr., 1673, 524; Pluk., Phyt., 1691, t. 226, p. 2.
Aubergine violette longue. Decaisne & Naudin, Man., iv. 287.

b. CALYX SPINY.

Aubergine violette longue. Vilm., 1883, 24.

IV. The *Oblong*, or *Pear-Shaped*. This form is a swollen fruit with an elongation towards the summit, in some of its varieties shaped like the powder-horn gourd.

a. CALYX NOT SPINY.

Melantzana nigra. Lugd., 1587, ii., app., 23.
Aubergine violette nain tres hative. Vilm., 1883, 26.
Early Round Violet. Damman, 1884.

b. CALYX SPINY.

Solanum pomiferum magnus fructu, etc. Pluk., Phyt., 1691, t. 226, p. 3.
Melongena. Tourn., 1719, t. 65.
American Large Purple. Burr, 1863, 609.

We may note that the Arabic words melongena and Bedengiam were applied by Rauwolf to the long-fruited form, the

[1] American Horticulturist, Sept. 1886, p. 10.

calyx not spiny, while the word Batleschaim, or Melanzana Batleschaim, was applied to the spiny-calyx form of the pear-shaped, —if Gronovius's[1] synonymy is to be trusted.

Every type in the varieties that I have seen under cultivation can be, with certainty, referred to one of the four forms above named. The oval-form type is figured in 1542, as we have shown; the round type in 1648, in Brazil; the long type, by Dalechamp, in 1587; and the pear-shaped type also in 1587. All the colors now noted, and more, receive notice in the ancient writers. As we have confined our synonymy to those authors who have given figures, and have omitted those who but described, however certainly the descriptions would apply, we can claim accuracy as to our facts.

We, hence, have no evidence that types have originated through cultivation in recent years, and we have strong evidence that types have continued unchanged through long-continued cultivation under diverse climates. It is but as we examine variation within types that we see the influences of cultivation. It is not altogether in size. The oval-fruited is described by Dodonæus (1616) as of the form and size of an egg, but he says that in Ægypt, where the plant is wild, it attains double or three times this size, which it has in France and Germany. Ray, in 1686, compares the size of the long-fruited to that of an egg, or of a cucumber,—a comparison that would answer for to-day, as cucumber size covers a wide range; but he adds that the curved form is like a long gourd. The figures of the pear-shaped in 1719 indicate a fruit which compares well with the usual sizes grown at the present time. It is in regularity of form, and in the large size of selected strains, that we see the influence arising from careful selection and protected growth. What other influence has climate exercised? We do not know.

This sketch illustrates the point I have already made in my study of the dandelion, celery, and other vegetables,—that types of varieties have great fixity, are not produced through human selection and cultivation, and, I wish I could add in this case, originated from wild prototypes; but, unfortunately, I find no particular records of the variation observed in feral, or spontaneous plants.

[1] Gronovius, Orient., 25, 26.

Elecampane. *Inula helenium* L.

The use of this plant is now nearly abandoned, although it was once highly regarded as an aromatic tonic. Columella, Pliny, and Palladius mention its culture by the Romans of the first and third centuries. Vegetius Renatus, about the beginning of the fifth century, calls it *Inula campana*, and St. Isidore, in the beginning of the seventh, names it *Inula*, adding "quam *Alam* rustici vocant." It is frequently mentioned in Anglo-Saxon writings on medicine before the Norman conquest, and was the "marchalan" of the Welsh physicians of the thirteenth century, and was generally well known during the middle ages.[1] The root is the valuable part, and it was used for candying into a sweetmeat, as well as for a medicine, and is sometimes even now used in distilling *absinthe* in order to give a flavor. It was in American gardens in 1806,[2] and its seed is yet advertised in some of our seed-catalogues.

The *Elecampane* is called, in France, *aulnée*, *aromate germanique*, *aunée*, *œil-de-cheval;* in Germany, *alant;*[3] in Anglo-Saxon, *hors-helene;* in Italy, *elenio* or *enula campana.*[4]

The plant, now naturalized in places in the United States, is native to Southern and Central Europe, extending eastward to the Caucasus, Southern Siberia, and in the Himalayas. It also occurs in Southern England and Ireland, Norway, and Finland.

Endive. *Cichorium endivia* L.

There are two distinct forms of endive,—the one the curled, the other the broad-leaved. The first does not seem to have been known to the ancients, although Dioscorides[5] and Pliny[6] name two kinds. In the thirteenth century Albertus Magnus[7] names also two kinds, the one with narrower leaves than the other; and in 1542 Fuchsius[8] figures two kinds of like description, and like forms are noted in nearly all the earlier botanies. A curled broad-leaved form is figured by Camerarius[9] in 1586; Dalechampius,[10] 1587; Gerarde,[11] 1597, etc. It is, however,

[1] Pharmacographia, 1879, 380.
[2] McMahon, Am. Gard. Kal., 1806.
[3] Vilmorin, Les Pl. Pot., 28.
[4] Pickering, Ch. Hist., 461.
[5] Dioscorides, lib. ii. c. 147.
[6] Pliny, lib. xx. c. 29, 32.
[7] Albertus Magnus, De Veg., Jessen ed., 1867, 508.
[8] Fuchsius, De Stirp., 677, 678.
[9] Camerarius, Epit., 1586, 283.
[10] Hist. Gen., Lugd., 1587, 557.
[11] Gerarde, Herbal, 1597, 221.

described in the "Adversaria,"[1] 1570. These authors named all furnish what may reasonably be considered as the types of the four kinds of broad-leaved endives now described by Vilmorin.[2] The origin of the curled endives, of which Vilmorin describes twelve, I find difficult to trace. The peculiar truncate appearance of the seed-stalks is very conspicuous, and this feature would lead me to suspect that the type is to be seen in the *Seris sativa* of Lobel[3] (1576), but the resemblances, I must confess, are quite remote. This is the *Cichorium latioris folii* of Dodonæus[4] (1616). They were in English gardens as a well-known sort in 1778,[5] and were named among seedsmen's supplies in 1726;[6] in the United States prior to 1806.[7]

The endive is called, in France, *chicorée endive;* in Germany, *endivien, winter-endivien;* in Flanders and Holland, *andijvie;* in Denmark, *endivien;* in Italy, *indivia, endivia;* in Spain, *endivia, escarola;* in Portugal, *endivia.*[8] The curled forms are called, in France, *chicorées;* the broad-leaved form, *Scaroles;* in English, *Batavian;* in Arabic, *Sjikuri;* by Turks, *hiddiba;*[9] in Egypt, *hendibe;* in Egyptian, *saris, serin;*[10] in India, *kasnee;*[11] in Japan, *fanna tsisa;*[12] Hindustani, *kasni;* Tamil, *koschi.*[13]

In 1885, a curled endive, at the New York Agricultural Experiment Station, was crossed by lettuce-pollen. The crop of 1886 showed a plant resembling the lettuce in leaf, but with the flower of the endive. We may explain this result as being a case of atavism, the stimulus of the foreign pollen bringing out one of the lettuce-like broad-leaved forms, which had shared in the parentages from which the curled was evolved.

English Bean. *Vicia faba* L.; *Faba vulgaris* Moench.

The culture of the English or broad-bean precedes the period of written history, as the seeds have been found not only in the Egyptian tombs of the twelfth dynasty, or from two thousand

[1] Pena and Lobel, Adv., 1570, 86.
[2] Vilmorin, The Veg. Gard., 1885, 243, 244.
[3] Lobel, Obs., 1576, 114.
[4] Dodonæus, Pempt., 1616, 634.
[5] Mawe, Gard., 1778.
[6] Townsend, Seedsman, 1726, 20.
[7] McMahon, Am. Gard. Kal., 1806.
[8] Vilmorin, Les Pl. Pot., 89.
[9] Forskal, Fl. Ægypt-Arab., xxx.
[10] Pickering, Ch. Hist., 257.
[11] Speede, Ind. Handb. of Gard., 167.
[12] Thunberg, Jap., 304.
[13] De Candolle, Orig. Des Pl. Cult., 78.

two hundred to two thousand four hundred years before Christ,[1] and have been excavated from the ruins of Troy,[2] but appear among the débris of the bronze age of the lake-dwellers of ancient Switzerland,[3] and the variety found continued to the times of the Romans.[4] Beans were also found at Teneriffe[5] at the period of the discovery; and Bretschneider[6] records that, about 140–86 B.C., during the reign of the Emperor Wu-ti, the celebrated general Chang-kien brought the bean from Western Asia; but these were probably only better varieties than those then grown in China. The bean was grown by the ancient Romans and Greeks, and finds frequent mention in their writings, and in Egypt was subject to many superstitious beliefs and prejudices.[7] This bean is now more or less cultivated in all quarters of the globe. It reached the British North American Colonies early in the seventeenth century, having been planted by Gosnold in the Elizabeth Islands, near the coast of Massachusetts, in 1602. Beans were under cultivation also in Newfoundland as early as 1622, in New Netherlands in 1644, and in Virginia prior to 1648.[8] At the present time Vilmorin[9] describes twelve garden and four field varieties as worthy of culture in France. In England this bean is very extensively grown. Dr. Alefield[10] had separated forty varieties in 1862. In America they are but little grown, and our best seed-catalogues enumerate no more than four varieties.

Linnæus forms this bean into two botanical varieties, as does also Moench, who names the one *hortensis*, or the garden bean; the other *equina*, or the horse-bean. These are both figured or mentioned by the early botanists: the *hortensis* or garden bean by Fuchsius (1542), Tragus (1552), etc.; the *equina* is described by Pena and Lobel in their "Adversaria" (1570), and by Lyte in his "Dodoens" (1586), as well as by Dodonæus in 1566.

[1] G. Schweinfurth, Nature, Jan. 31, 1883, 314.
[2] De Candolle, Orig. Des Pl. Cult., 272.
[3] Gard. Chron., 1866, 1068; De Candolle, Orig. Des Pl. Cult., 255.
[4] Darwin, An. and Pl., 1868, i. 385.
[5] Gen. Coll. of Voy. of the Port, London, 1789, 183.
[6] Bretschneider, On the Study, etc., 15.
[7] For an excellent summary, see "Travels of Anacharsis," Phila., 1804, iv. 154-157.
[8] U. S. Pat. of Rept., 1553, 221. [9] Vilmorin, Les Pl. Pot., 1883, 210.
[10] Alefield, Bonplandia, x. 1862, s. 348; quoted from Darwin, l. c.

I am too unfamiliar with the English bean to attempt a synonymy. R. T[hompson][1], in 1850, describes ten varieties, giving synonymes, and these include all sufficiently known to him. Let us follow up his synonymy, in order to see whether varieties of modern origination appear. This synonymy, we must caution, is founded upon identity of names in the most instances, and applies to the garden bean only, yet collateral evidence would seem to indicate a substantial correctness:

1. *Early mazagan.* R. T., 1850. Brought from a settlement of the Portuguese on the coast of Africa, just without the Straits of Gibraltar. Mill. Dict., 1807.
   Early mazagan. Mawe, 1778; Bryant, 1783; McMahon, 1806; Thorb. Cat., 1828; Thorb. Cat., 1884.
   Feve naine hative. Noisette, 1829; Vilm., 1882.

2. *Marshall's Early Dwarf Prolific.* R. T., 1850.

3. *Long-pod.* R. T., 1850.
   Long-pod. McMahon, 1806.
   Early long-pod. Mawe, 1778; Bridgeman, 1832; Loudon, 1860.
   Early Portugal or *Lisbon.* Mawe, 1778; Mill. Dict., 1807.
   Early Lisbon. McMahon, 1806; Bridgeman, 1832.
   Turkey long-pod. Mawe, 1778; McMahon, 1806; Bridgeman, 1832.
   Tall long-pod. Mawe, 1778.
   Sandwich. J. W., Gent., 1683; Townsend, 1726; Stevenson, 1765; Mawe, 1778; Bryant, 1783; Bridgeman, 1832.
   Sword long-pod. Thorb. Cat., 1828; Fessenden, 1828; Bridgeman, 1832; Thorb. Cat., 1884.
   Hang-down long-pod. Vil., 1883.
   Feve à longue cosses. Noisette, 1829; Vil., 1883.

4. *Green long-pod.* R. T., 1850.
   Green Genoa. McMahon, 1806; Bridgeman, 1832.
   Green Nonpareil. McMahon, 1806; Thorb., Gard. Kal., 1821; Fessenden, 1828; Bridgeman, 1832; Thorb. Cat., 1884.

5. *Dutch long-pod.* R. T., 1850; Loudon, 1860.

6. *Windsor.* R. T., 1850.
   Broad Windsor. Mill. Dict., 1807; Fessenden, 1828; Loudon, 1860; Thorb., 1884.
   Kentish Windsor. Bridgeman, 1832.

[1] R. T., Gard. Chron., 1850, 84.

Taylor's Windsor. Bridgeman, 1832.
Mumford. Mawe, 1778; Bryant, 1783; McMahon, 1806; Bridgeman, 1832.
Small Spanish. Mawe, 1778; Bryant, 1783.
Windsor. Stevenson, 1765; Mawe, 1778; Bryant, 1783.
Large Windsor. Van der Donck, 1653; in present New York.

7. *Green Windsor.* R. T., 1850.
Toker. Stevenson, 1765; Mawe, 1778; Bryant, 1783; Bridgeman, 1832.
Feve de Windsor verte. Vil., 1883.

8. *Green China.* R. T., 1850.

9. *Dwarf Crimson-seeded.* R. T., 1850.
Feve très naine rouge. Vil., 1883.

10. *Dwarf Fan.* R. T., 1850.
Dwarf Fan or *Cluster.* Mawe, 1778.
Dwarf Cluster. McMahon, 1806; Bridgeman, 1832.
Feve naine hative à chassiz. Vil., 1883.

11. *Red-blossomed.* Mawe, 1778; McMahon, 1806; Bridgeman, 1832; R. T., 1850.

12. *White-blossomed.* Mawe, 1778; McMahon, 1806; Bridgeman, 1832; R. T., 1850.

The only two other varieties I have seen advertised lately are Beck's Dwarf Green Gem and Seville long-pod.

There is certainly no indication here that types have appeared in modern culture. The crowd of new names which appear during a decade gradually become reduced to a synonymy, and we find at last that the variation gained has been within types only.

The European names of the broad-bean, or English bean, are: Denmark, *valske bonner;* in Flanders, *platte boon;* in France, *feve, gorgane, gourgane;* in Germany, *Garten bohnen, sau bohnen, puff bohnen;* in Holland, *tuin boonen, roomsche boonen;* in Italy, *fava;* in Portugal, *fava;* in Spain, *haba.*[1] Other generic names are: Arabic, *ful* or *foul;* Hebrew, *phul* or *pol;* Celtic, *fa, fas, fav;* Slav, *bob* or *bobu;* Berber, *ibiou;* Basque, *baba.*[2]

[1] Vilmorin, Les Pl. Pot.
[2] De Candolle, Geog. Bot., 956; Orig. Des Pl. Cult., 253.

The horse-bean is called, in France, *feverole;* in Germany, *pferde oder feld bohne;* in Italy, *fava cavallina.*[1]

EVENING PRIMROSE. *Œnothera biennis* L.

The roots may be used as Scorsonera, but it is cultivated in France only as a curiosity.[2] It is said by Loudon[3] to be cultivated in Germany, and in Carniola the roots are eaten in salad.[4] It was once under English culture.[5] A native of Northern America, it first reached Europe in 1614.[6] It is given by Burr[7] for American gardens in 1863, under the name *German Rampion.* It is called, in France, *Œnothere bisannuelle, onagre, herbe aux anes, jambon, jambon des jardiniers, jambon de St. Antoine, lysimachie jaune, lysimachie jaune cornu, mache rouge;* in Germany, *rapuntica;* in Flanders, *ezelskruid;* in Italy, *rapontica, rapunzia;* in Norway, *natlys.*[8]

(To be continued.)

THE PERISSODACTYLA.

BY E. D. COPE.

DIPLARTHRA.

IT is to the order Diplarthra that the greater number of existing species of hoofed mammals belong. It is represented by two sub-orders, which have the following definitions:

Astragalus truncate distally; the median toe the largest;.....*Perissodactyla.*
Astragalus with the distal end convex anteroposteriorly, forming a ginglymus (hinge-joint); number of toes generally even, the median two the largest;.....*Artiodactyla.*

[1] NOTE.—The references in the list are to Bridgeman, Young Gard. Assist., N. Y., 1832; Bryant, Fl. Dict., Lond., 1783; Fessenden, New Am. Gard., 1828; Loudon, Hort. Lond., 1860; McMahon, Am. Gard. Kal., Phila., 1806; Mawe, Univ. Gard., Lond., 1778; Noisette, Man., Brussels, 1829; Stevenson, New and Comp. Gard. Kal., Dublin, 1765; Thorburn, Gent. and Gard. Kal., N. Y., 1821; Thorburn's seed-catalogues, 1828, 1884; Townsend, Comp. Seedsman, Lond., 1726; Vilmorin, Les Pl. Pot., Paris, 1883.

[2] Vilmorin, Les Pl. Pot., 202.

[3] Loudon, The Horticult., 1860, 653.

[4] Flore Nat. et Econ., Pt. 2, p. 398.

[5] Johnson, Useful Pl. of Gt. Brit., 104.

[6] Linnæus, Sp., 1763, 492.

[7] Burr, Field and Gard. Veg., 1863, 35.

[8] Schubeler, Culturpflanz de Norv., 118.

No undoubted connecting forms between these sub-orders have been discovered, although they approximate at various points. Thus, in the genus Menodus there are but four toes in the anterior foot, and the median two do not differ much in length. In the same genus the distal extremity of the astragalus is somewhat convex, and the facet for the cuboid bone is large, somewhat as in the hippopotamus; but the angle separating the two facets is diagonal, and not transverse; so that the astragalus cannot move on the cuboid and navicular bones and form a ginglymus, as it does in the Artiodactyla. In a few instances some Artiodactyla have teeth which resemble those of the Perissodactyla; for instance, the genus Listriodon. Both sub-orders probably arose from an undiscovered common ancestor, which was a member of the order Amblypoda. It was probably a type with tubercular molars, and belonged to the Puerco epoch. An approach to this theoretical type is made by the Pantolestidæ, whose molars are bunodont, the superior molars being tritubercular (with two intermediates); but the form of the extremities (the posterior only is known) is that of the Diplarthra. The hypothetical Amblypoda with bunodont molars I have regarded as a sub-order, and have named the Hyodonta.[1]

The opinion has been expressed by Schlosser that the evolution of the Diplarthra, or alternate-wrist-and-ankle-jointed ungulates, has been directly from the Taxeopoda, or straight-rowed-wrist-and-ankle-jointed Ungulata, without intervention of the Amblypoda. The Periptychidæ have been cited as the probable ancestors of the Artiodactyla, and the Phenacodontidæ as ancestors of the Perissodactyla. I do not agree with this view, and for the following reasons:

The conversion of a taxeopod into a diplarthrous ungulate has been accomplished by the rotation outwards of the lower leg with the first row of the carpus and tarsus, on the second row, or by the rotation inwards of the second row on the first, in both the fore and hind feet. This rotation has resulted sooner or later in the loss of the internal digit (thumb and great toe) from both extremities. In the history of this sliding outwards of the first row, the outside element of the row has always preceded in time the inside element. The Amblypoda (Fig. 2

[1] Proceeds. Amer. Philosoph. Society, 1882, 446.

PLATE XXVIII.

Hyæna striata, striped hyena.
(From the Standard Natural History.)

show this clearly. The lunar bone has extended outwards so as to rest on the outside bone of the second row (unciform) in part, as well as the one on which it properly rests (magnum). But the scaphoid has not slipped outwards so as to rest on the magnum of the second row. That continues to rest on its proper successors below, the trapezoïdes and the trapezium, the latter taking half the burden. This structure (Fig. 2) is absolutely intermediate between that of the Taxeopoda (Fig. 1) and that of the Diplarthra (Fig. 3), and I imagine that all ungulates, in passing from the taxeopodous to the diplarthrous stages, traversed

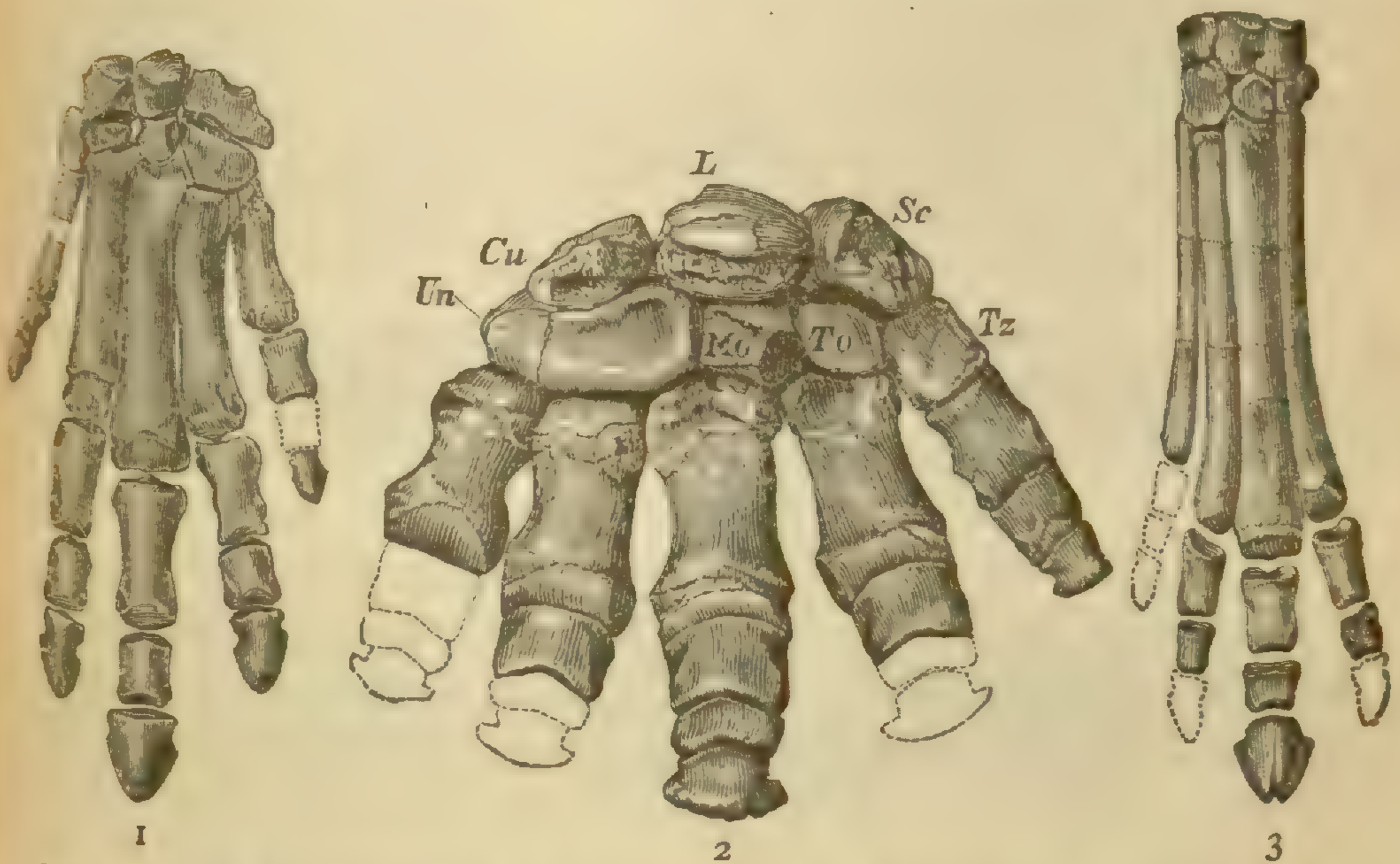


Fig. 1. *Phenacodus primævus*, left manus, one-third natural size. Original.
Fig. 2. *Coryphodon elephantopus*, right fore-foot, one-third natural size. Original.
Fig. 3. *Hyracotherium venticolum*, right fore-foot, two-thirds natural size. Original.

the amblypodous. The only other conceivable path would have been through a type in which the scaphoid had extended over the magnum, while the lunar did not pass outwards beyond the limits of the magnum. No such type has been found. On the other hand, I have shown that the Oredontidæ[1] have pushed the transposition of the bones of the first carpal row to such an extreme that the magnum has gotten entirely under the scaphoid, while the unciform supports the lunar completely. Thus the alternating position, with its useful mechanical consequence, has been lost to this group, the effect produced being exactly that

[1] Proceeds. Amer. Philosoph. Society, 1884, pp. 503–9.

seen in the Amblypoda. This may have had something to do with the extinction of the Oreodontidæ.

The cause of this rotation of the first on the second rows of carpal and tarsal bones may be now referred to. Mammals, except those which are completely plantigrade (as the bear), turn the toes out in walking.[1] In the Ungulata, the toes of the posterior foot are more strongly turned outwards than those of the anterior foot. In the digitigrade Carnivora, which represent the highest type of the Unguiculata, the movement is reversed, the anterior toes being turned outwards more than the posterior. As the foot is descending towards the ground, it is, with the distal part of the leg, rotated from within outwards. The rotation of the foot is promptly arrested at the moment of its contact with the ground, and the effect of this arrest is to produce a torsion of the leg, and a pressure from within outwards of the proximal or moving element of each articulation, against the distal or fixed element. Thus a constant torsion strain from within outwards has been exerted by the first row of carpal and tarsal bones, on the second row, and thus has arisen, as I believe, the gradual transition from the linear arrangement of those bones of the Condylarthra to their alternation seen in the Diplarthra. The advance of diplarthrism is in direct ratio to the advance of digitigradism, for the greater the length of the foot, the greater is the elasticity of the leg, and the greater is the torsion. This is especially true of the posterior leg, with its prominent heel; and thus is explained the fact that diplarthrism appears in that foot before it does in the fore foot, as in the Proboscidia. (Plate XXIX.)

To the same exterior torsion is to be ascribed the early extension of the radius and tibia over the first row of carpals, and the almost exclusion of the ulna and fibula from the articulation.

This reasoning when applied to the Unguiculate series is modified by other circumstances. In the Carnivora the weight of the body does not rest on the ungues as in the Ungulata, but on the pads of connective tissue beneath the digits. Consequently on the application of the foot to the ground the distal bones in the carpal and tarsal articulations do not present the rigid resistance seen in the Ungulata, but yield more or less to the tor-

[1] Familiar exception to this rule is seen in some horses; but the ass turns the toes out, and the tapir, which represents the horse's ancestors, turns the toes out also.

Gazella dorcas, gazelle.

(From the Standard Natural History.)

sion. Hence no alternation of these bones takes place in the hind foot of the Carnivora, where the eversion of the digits is moderate. In the case of the fore foot, the eversion and consequent torsion are so great that the alternation is produced (Plate XXVIII.). In the manus of the plantigrade bear the alternation is almost *nil.*

It may be here objected that the camel walks upon elastic pads as do the Carnivora, and yet the alternation does really take place. It is on this account (as I have maintained) that the distal metapodial tongue-keels were never completed in these animals. But if the camel does not rest on the ungues sufficiently to resist torsion, as in the Carnivora, this was not the case in the ancestors of the camels, the Poëbrotheriidæ, where the contact with the ground was much as in other Diplarthra. But there is little impact in the step such as occurs in other Ungulata, hence the failure to complete the keels.

Our zoological gardens furnish excellent opportunities for the verification of all these observations on the progression of Mammalia.

I. Perissodactyla.

The modifications of structure seen in the evolution of this sub-order are principally those of the feet, teeth, and vertebræ. As already remarked, the changes in the feet consist in the gradual reduction of the number of the digits from four, or perhaps five, to one. In the teeth the changes consist in the conversion of tubercular, or bunodont, into crested, or lophodont, molars, and in the increase in the complexity of the premolars, so that, instead of possessing a distinct and simple character of their own, they come to resemble the true molars; also in the reduction in the dimensions and numbers of the canine and incisor teeth in some lines. The modification of the vertebræ consists in the conversion of a flat zygapophysial articulation into a concavo-convex or embracing structure. This modification is similar to what is seen in some of the Artiodactyla, but the change is carried further, and the structure becomes more complex in the latter suborder.[1] In the teeth the change pursues two paths, both different from that seen in the Artiodactyla. The modifi-

[1] See "Systematic Arrangement and Phylogeny of Artiodactyla," in Proceeds. Amer. Philos. Society, September, 1887.

cation of the feet is of a different type, as already stated in the definitions of the two orders.

The first step in dental modification in the superior series is the flattening of the external tubercles, and their connection with each other at the base. The beginning of this process is seen in *Heptodon singularis* (Fig. 4) and its allies of the Hyracotheriinæ.[1] A concomitant change is the confluence of the internal cusps with the intermediate ones into crests or ridges, which may be transverse or oblique (Figs. 4, 12, and 15), or may be otherwise varied, as in the equine line. In the lower jaw two lines of change have developed. In the one the tubercles of the crown have been opposite, and have become joined in pairs by transverse ridges or crests (Fig. 12); while in the other the cusps have become alternate, so that the ridges which joined them have been oblique, each tubercle giving origin to two crests extending in divergent directions,—that is, to the cusps with which it alternates. The result has been a W-shaped crest or line of crests (Figs. 26 *b*, 28).

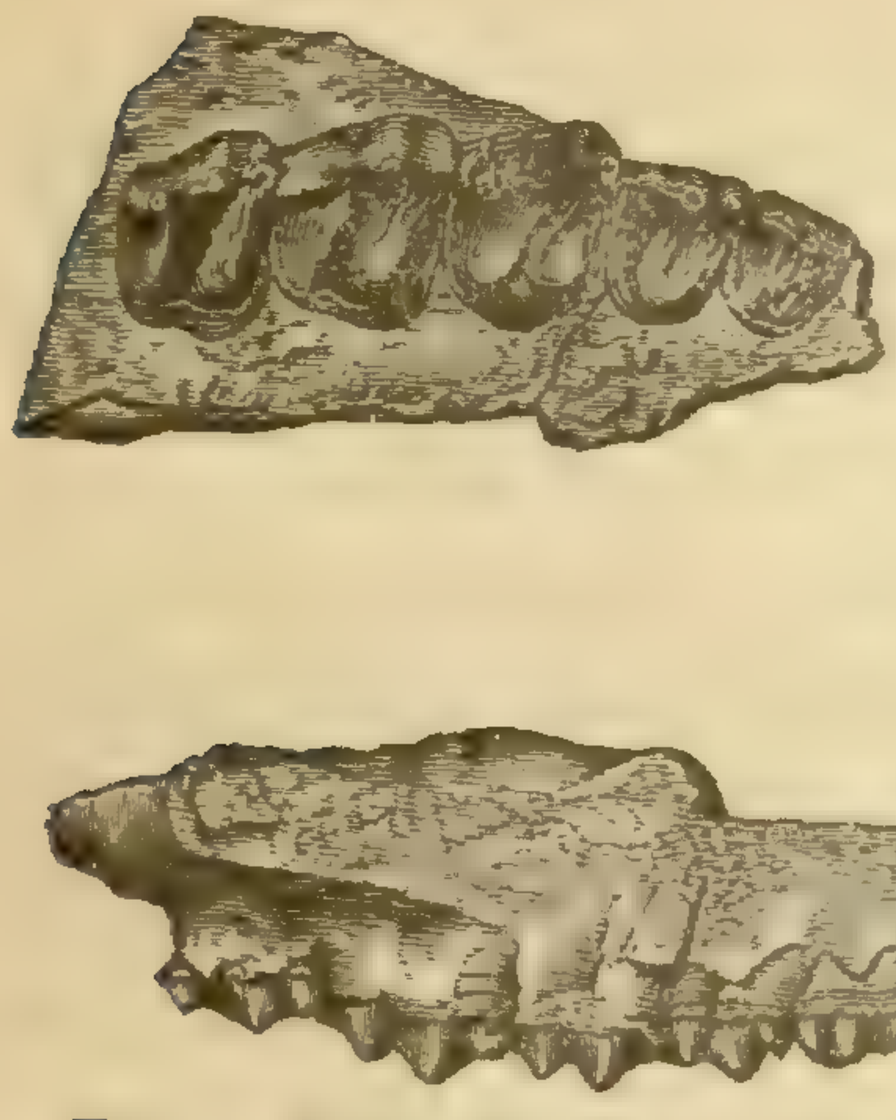


FIG. 4. Part of right maxillary bone of *Heptodon singularis* Cope; from the Wasatch beds of New Mexico. From Captain Wheeler's report, iv., ii. Pl. LXVI.

Ryder has pointed out that the rhinoceros masticates its food by the movement of the mandibular ramus from without inwards on the upper jaw. The same is true of the species of Equus (*E. montanus*, *E. asinus*, *E. caballus*). The same author points out that the masticatory movement in the selenodont Artiodactyla is in the opposite direction, from within outwards.[2] It appears to me probable that many of the primitive Perissodactyla had the same movement as the latter. They, however, present a remarkable difference from the selenodont Artiodactyla in another respect. The mandibular condyle in Hyracotherium

[1] These are frequently accompanied by an additional external cusp, which springs from the anterior external angle of the crown. (See Figs. 4, 8, 10.)

[2] Proceedings Academy Philada., 1878, p. 45. Although Professor Ryder afterwards gave up this view, and concluded that the Artiodactyla had the same movement as in the Rhinoceros (l. c., 1879, 47), his first opinion was undoubtedly the correct one.

Symborodon, etc., is strongly convex upwards, so that a lateral twist of the entire lower jaw in mastication becomes possible. The result of this has been to throw the masticating function almost entirely on the external cusps of the molars in both jaws. Thus is explained the fact that in this order the external cusps of the molars in both jaws only are modified, while the internal remain of relatively small dimensions, and often primitive form. In the tapir, where the movement in mastication is almost vertical, neither set of tubercles attains a remarkable specialization.

For the three modes of mastication mentioned the following terms are proposed: Vertical movement (Carnivora, Bunodonta), Orthal; from within outwards, Ental; from without inwards, Ectal (from ἀλετν, to grind).

The three lines which originated from the Lophiodontidæ are those which terminated in the Equidæ, the Tapiridæ, and the Rhinocerontidæ. They differ in the characters of the superior molar teeth as below pointed out. The mechanical cause of these peculiarities is not far to seek. In the Equine line mastication has been effected on that side of the mouth where the lower jaw, in its transverse motion across the superior molars, was moving from the inside outwards, as in the selenodont Artiodactyla (ruminants). In the Tapiroid line there has been little transverse movement of the lower jaw, so that V's have not been developed in the molars of either series. In the Rhinocerontine line mastication has been performed on that side of the mouth where the lower jaw was passing from the outside inwards. This is the method of mastication of the Rhinoceros to-day, as observed by Professor Ryder.[1] The effects of these distinct kinds of mastication are seen in different forms of the external walls of the superior molars. In the Equine line (Chalicotheriidæ, Menodontidæ, and Palæotheriidæ) the edges of the external cusps have been drawn externally by the ental movement of the lower jaw, thus producing the legs of the two V's. In the Rhinocerontine line the branches of the single large anterior V have

[1] Proceeds. Academy Philadelphia, 1879, p. 49. In this paper Professor Ryder recedes from his position that the V's of the selenodont superior molar have been produced by the ental movement, and endeavors to demonstrate that they have arisen by pressure on the cusps by an ectal movement. This view is negatived by the fact that it is not the apices of the cusps which are engaged in primitive mastication, but their sides and lateral ridges. The former fall between the cusps of the opposite jaw.

been drawn inwards by the ectal movement of the lower jaw, so that the external wall slopes inwards at the point where it forms in the horse line a V with the angle outwards. In some of the genera (as Isectolophus) a median, inwardly-directed V is developed at this point. The posterior end of the wall is turned a little outwards in some forms of this series, but this is due to a return or ental movement of the lower molar, of short duration, which has also drawn out externally the external end of the anterior cingulum. The two lines of development are also indicated in the lower molars. The one has V's on the lower molars, and the other has cross-crests. The development of V's is due to the development of intermediate tubercles of the superior molars. These cause the crown of the inferior molar to pursue a curved path across the upper, so that when the external cusp of the inferior molar is deflected forwards by the intermediate cusp of the superior, the inner cusp of the former must alternate with the external of the same, in order to pass between the internal cusps of the superior molar.[1]

With these preliminary remarks, I give the following synopsis of the families:[2]

I. No Λ-shaped space with the apex external between cusps of superior molars. Inferior molars with cross-crests.

A. Premolars different from molars.

a. Superior canine teeth present.

1. Toes 4–3; ..... *Lophiodontidæ.*
2. Toes 3–3; ..... *Triplopodidæ.*

aa. No superior canine teeth.

3. Mastoid bone not exposed in external wall of skull; ..... *Cænopodidæ.*

AA. Superior molars and premolars alike, with cross-crests.

a. External cusps of superior molars fused into a wall.

4. Mastoid bone forming part of the external wall of the skull; superior canines present; ..... *Hyracodontidæ*
5. Mastoid bone excluded from the walls of the skull by the contact of the occipital and squamosal; no superior canines; ... *Rhinocerida.*

aa. Exterior cusps of superior molars subequal, distinct.

6. Superior molars and premolars alike, and with cross-crests; toes 4–3; ..... *Tapiridæ.*

II. The external cusps of the superior molars subequal, separated by an Λ-shaped space, with the apex external; inferior molars with crescents.

A. Superior premolars different from molars; with only one internal cusp.

7. Toes 4–3; a vertebrarterial canal; ..... *Chalicotheriidæ.*

[1] These relations will be more fully discussed and illustrated in an article shortly to appear.

[2] Modified from that published in the Proceeds. Amer. Philos. Soc., 1881, p. 373.

8. Toes 3–3; no vertebrarterial canal;.....*Macraucheniidæ.*

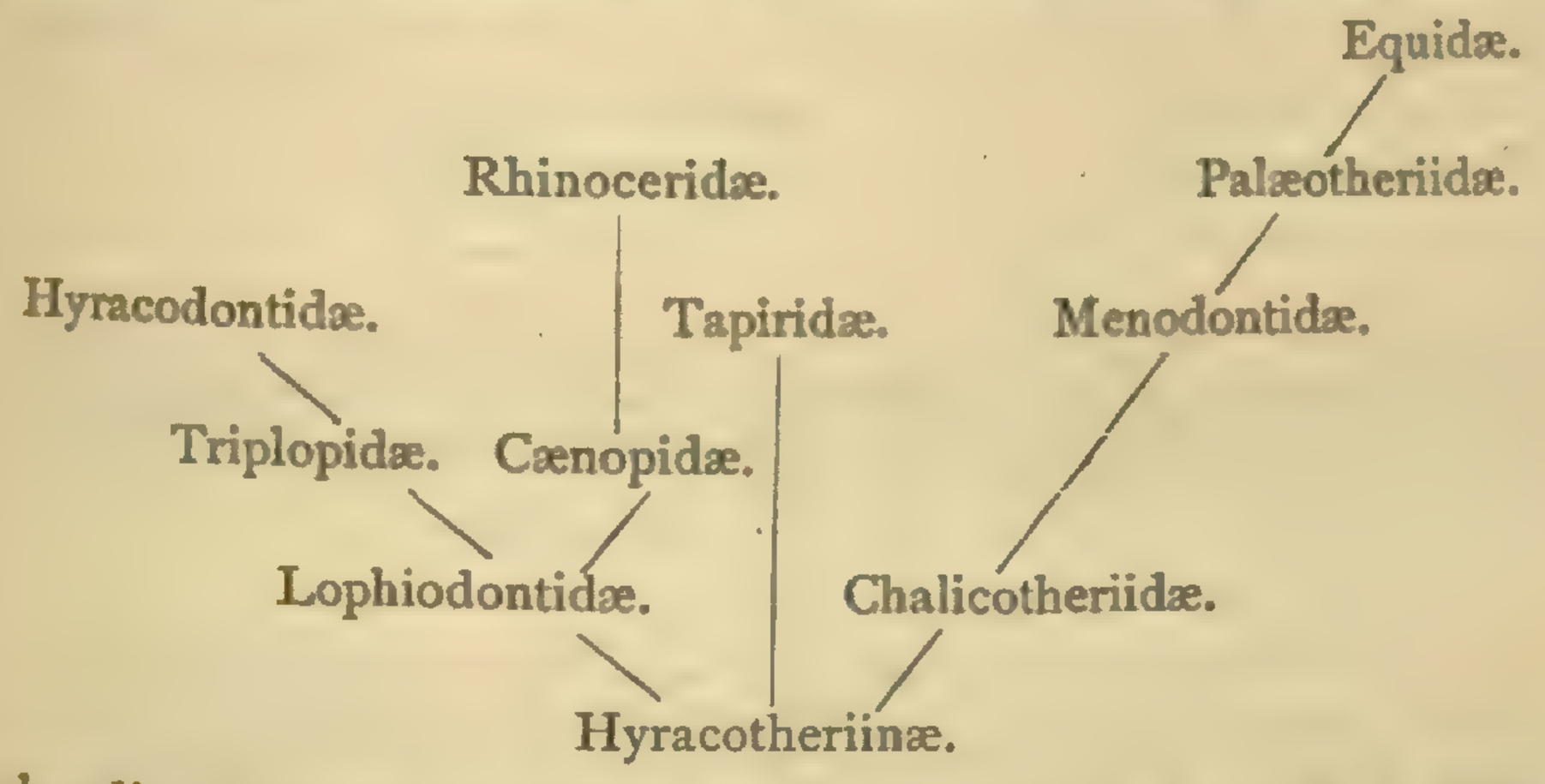
AA. Premolars like molars, with two internal lobes above.

9. Toes with digits 4–3;.....*Menodontidæ.*

10. Toes with digits 3–3;.....*Palæotheriidæ.*

11. Toes with digits 1–1;.....*Equidæ.*

The total number of well-determined species of this order is about two hundred. It was abundantly represented during the Eocene period, and the recent species are comparatively few. It may be also observed that certain families predominated during certain periods. Thus the prevalent *Perissodactyla* of the Eocene are *Lophiodontidæ* and *Chalicotheriidæ;* those of the Miocene are *Rhinocerontidæ* and *Palæotheriidæ.* The *Tapiridæ* and *Equidæ* characterize the latest tertiary epochs. A genealogical tree of the order may be constructed as follows:



The leading types of the order, divisions I. and II., differ only in the two points of the separation or non-separation of the exterior cusps of the superior molars by a V-shaped interspace, and the transverse or oblique crests of the inferior molars. That no great modification of known forms (as *Lambdotherium* in the *Chalicotheriidæ*, and *Hyracotherium* in the *Lophidontidæ*) would be necessary to obliterate this difference is quite clear. How readily the transverse-crested lower molar can be modified into the V-bearing type may be seen by comparing the inferior molars of *Hyracotherium* with those of a rhinoceros.

The LOPHIODONTIDÆ includes a larger number of known species than any of the others of the order. With one exception, all the species belong to the Eocene period. They range from the size of a rabbit to that of an ox. They resembled most, among living animals, the tapirs.

The genera are characterized as follows:

I. External lobes of superior molars well separated and little flattened; lobes of inferior molars scarcely united (*Hyracotheriinæ*).

A. No diastemata.
a. Fourth inferior premolar unlike the first true molar.
Last inferior molar with five lobes; superior premolars four;..... .....*Systemodon* Cope.
AA. A diastema behind the first premolar in both jaws.
a. Last inferior premolar different from first true molar.
Last inferior molar with heel; cross-crests of superior molars interrupted;.....*Hyracotherium* Owen.
aa. Last inferior premolar like first true molar.
Dentition generally as in Hyracotherium.....*Pliolophus* Owen.

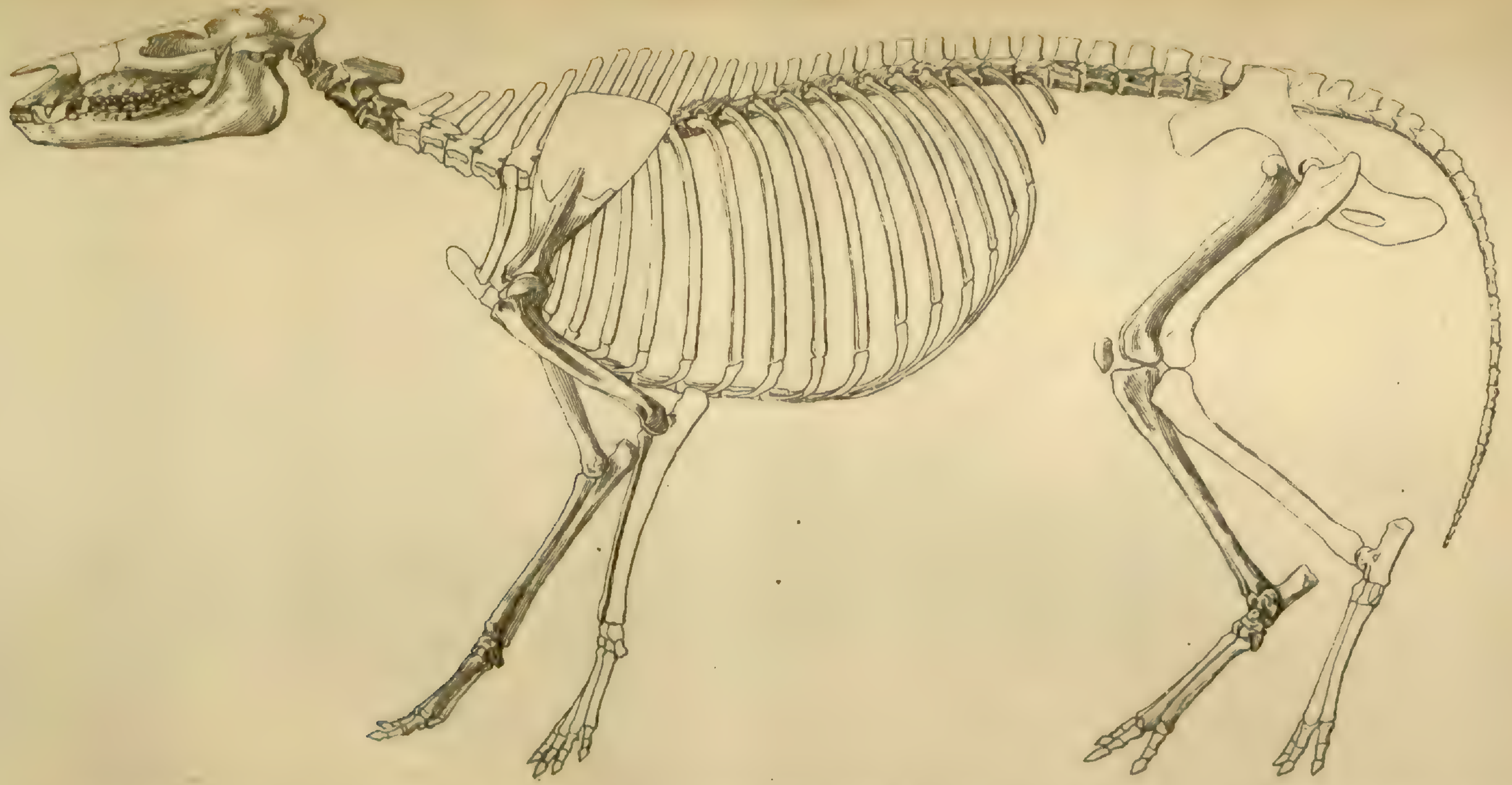
II. External lobes of superior molars well separated and little flattened; inferior molars with perfect cross-crests (*Protapirinæ*).
Last inferior molar with heel; ? four premolars;.....*Isectolophus* S. and O.
Last inferior molar without heel; inferior premolars three;..*Protapirus* Filh.

III. External lobes of superior molars flat, not well distinguished, forming a wall. Inferior molars with perfect cross-crests (*Lophiodontinæ*).
"A. No diastema in lower jaw.
Last inferior molar with third lobe;.....*Helaletes*" Marsh.
AA. Lower jaw with diastema.
* No diastema behind first premolar.
a. No inferior premolars like the true molars.
Superior molars 7.
Last inferior molar with heel;.....*Heptodon* Cope.
Last inferior molar without heel;.....*Hyrachyus* Leidy.
Superior molars 6.
Last inferior molar with heel;.....*Lophiodon* Cuv.
Last lower molar without heels, no horns;.....*Dilophodon* Scott.
Last lower molar?; "an attachment for a dermal horn on each nasal bone;".....*Colonoceras* Marsh.

The above table shows that the modification which this family has undergone in its superior molars, has consisted in the confluence of the external tubercles into a more or less irregular external wall to the crown, and the confluence of the intermediate and internal tubercles into cross-crests. In the lower molars cross-crests have been formed. It is impossible to separate the Hyracotheriine sub-family as a family from the Lophiodontinæ, since the characters grade into each other completely. But it has been from the Hyracotheriine sub-family that the horse line was derived; the Protapirinæ gave origin to the Tapiridæ; while the rhinoceroses have descended from the Lophiodontinæ.

Among Hyracotheriinæ the genus Systemodon (Cope) holds the lowest place on account of the entire absence of diastemata from the dental series. It is as old as any of the genera, occur-

PLATE XXX.



Hyracotherium venticolum, Cope, skeleton restored, one-third natural size; from the Wasatch beds of Wyoming, N. A. Original except ribs, which are after Osborn. Unshaded portions not preserved in specimen, which is in Coll. E. D. Cope.

ring in the Wasatch (or Suessonian) epoch. A common ancestor gave origin to Systemodon and Hyracotherium. It resembled the former in the absence of diastemata, and the latter in the

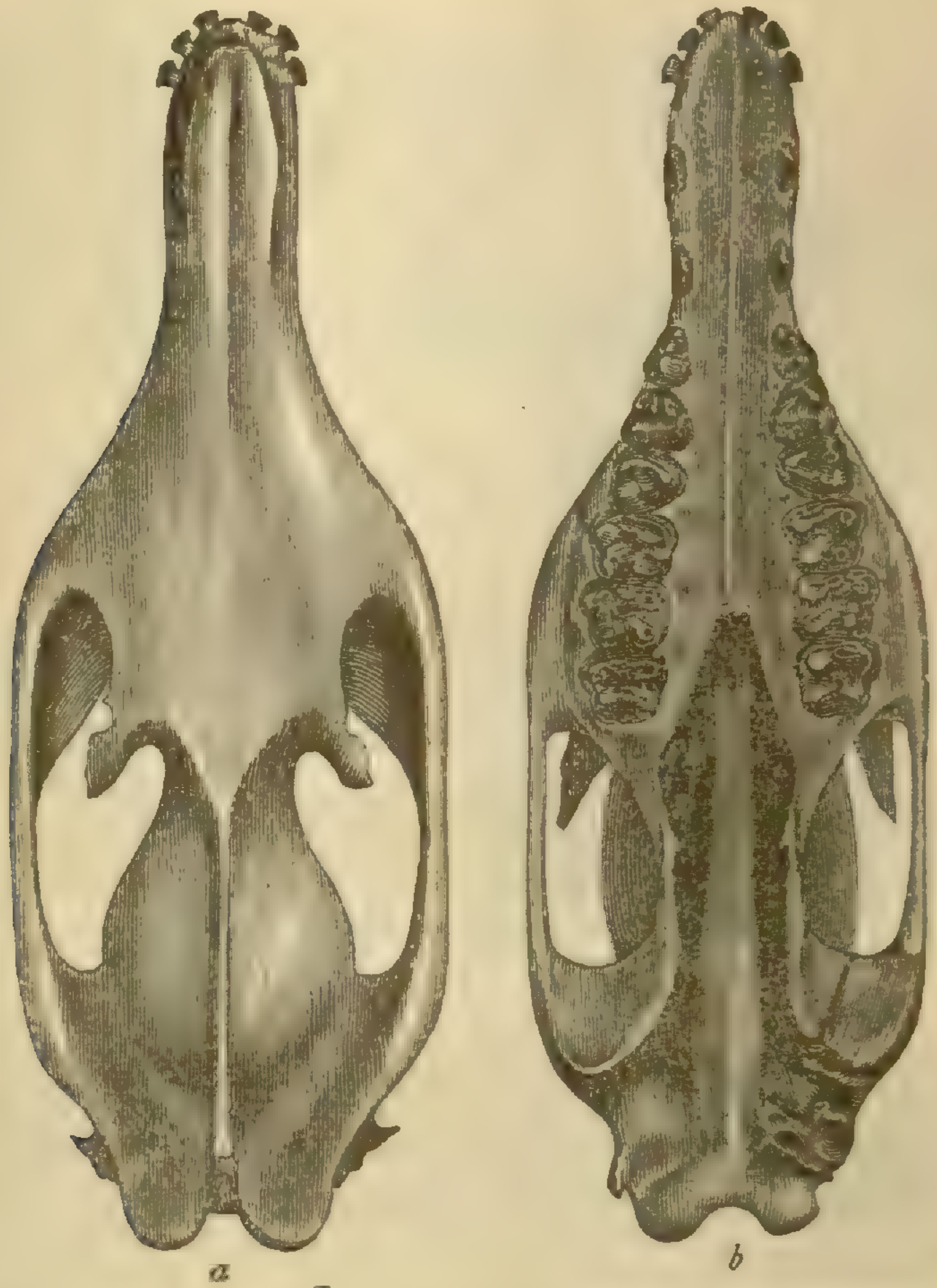
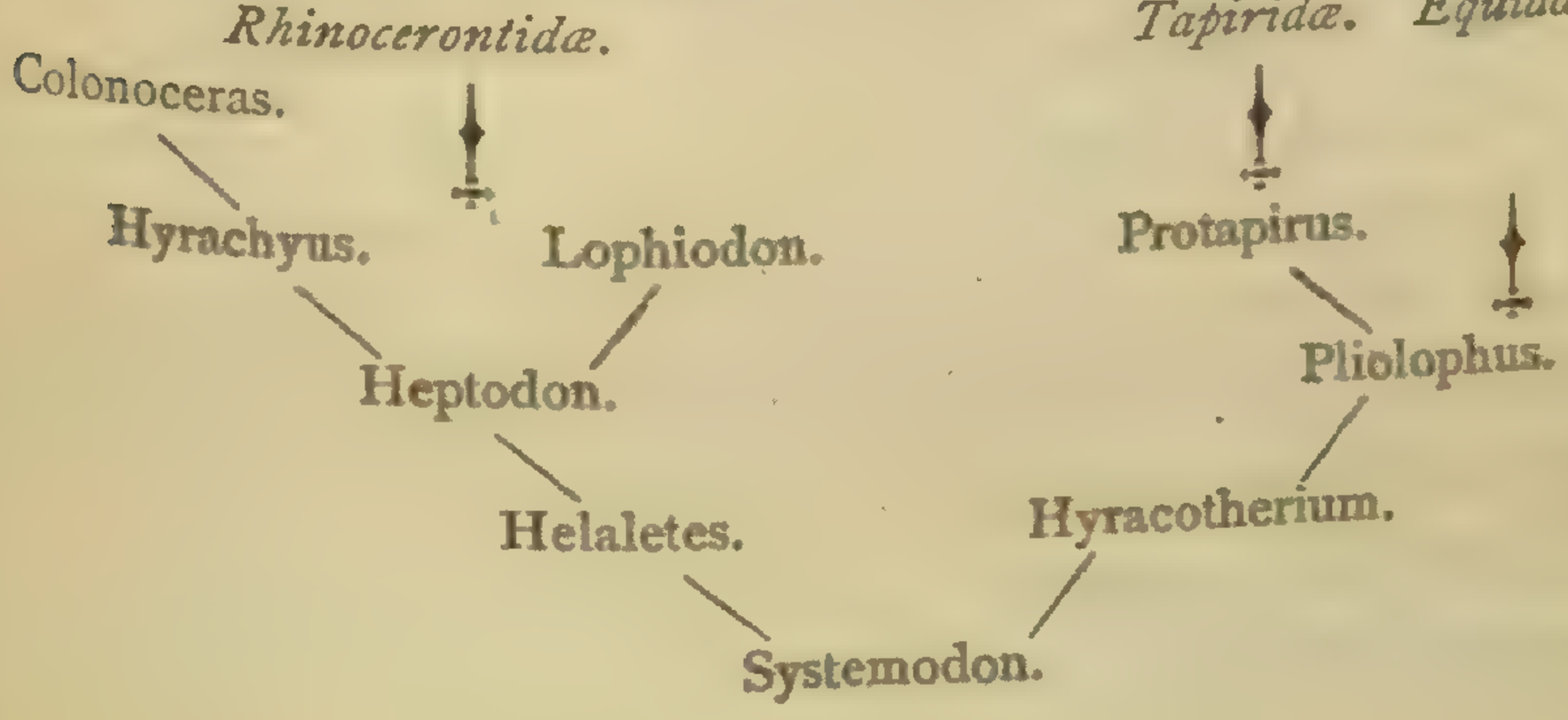


FIG. 5. Skull of *Hyracotherium venticolum* Cope, three-quarters natural size; from Wind River Eocene of Wyoming. Original. Fig. *a* from above; *b* from below.

greater distinctness of the cusps of its molars. The succession of the genera may be represented somewhat as follows:



In the Lophiodontine line we have Helaletes (Marsh) without diastema, like Systemodon. In Heptodon the diastema appears,

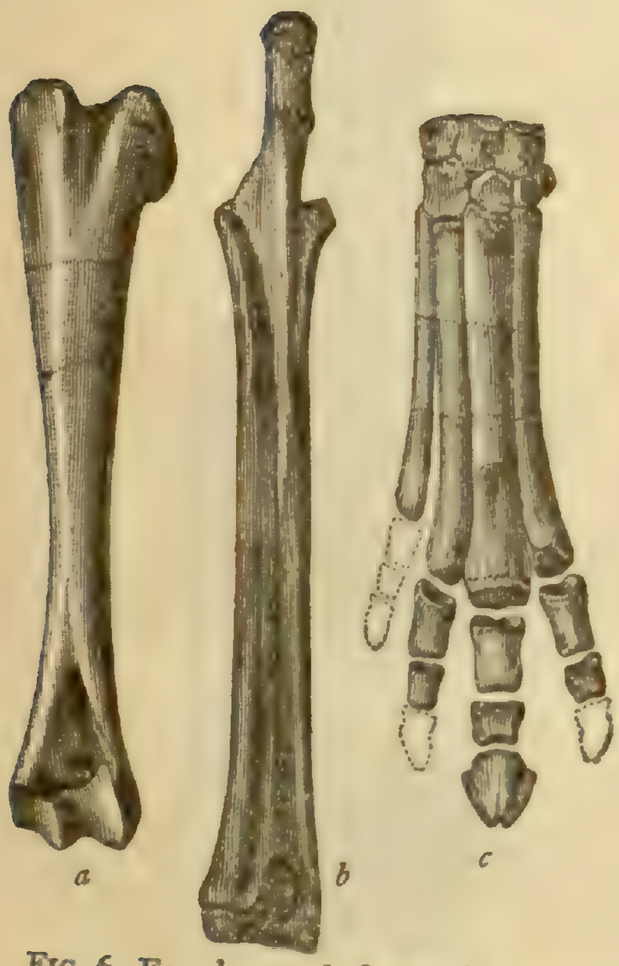


FIG. 6. Fore-leg and foot of *Hyracotherium venticolum* Cope, two-thirds natural size; from Eocene beds of Wind River, Wyoming. Original, from "Report U. S. Geol. Surv. Terrs.," iii. Fig. *a*, humerus from front; *b*, ulna and radius from behind; *c*, anterior foot from before.

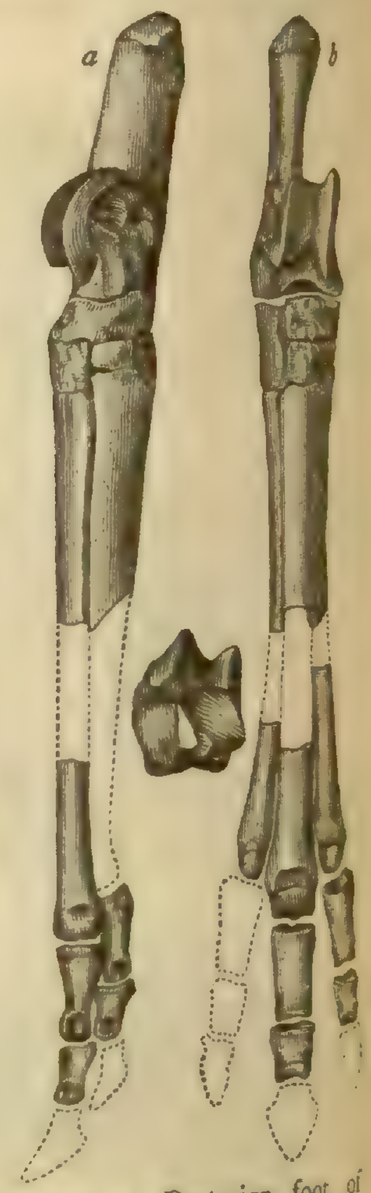


FIG. 7. Posterior foot of specimen of *Hyracotherium venticolum* already figured: *a*, left side; *b*, from front; *c*, distal end of astragalus and calcaneum.

and in the succeeding genera the first premolars are lost. In Hyrachyus the heel of the last inferior molar vanishes, while the nasal bones bear traces of dermal horns in Colonoceras (Marsh). The transition from Hyrachyus to the Rhinocerontid series is not difficult. The nearest form is Cænopus of the Cænopodidæ, which only differs from Hyrachyus in the lack of the canine teeth above, and of the middle incisors. The passage to the Tapiridæ is equally easy, through the close resemblance of Protapirus (Filh.) to Tapiravus (Marsh) of the

latter family. The latter only differs from the former in the increased complexity of the premolars. The passage to the horse line is suggested by the resemblance of Pliolophus

FIG. 8. *Systemodon tapirinus* Cope, dentition; upper figure, right superior molars from below; lower figure, left inferior molars from above; natural size. Original; from Wasatch bed of Wyoming.

FIG. 9. *Heptodon ventorum* Cope, superior molars of left side, natural size. Original; from Wind River beds of Wyoming. From "Report U. S. Geol. Surv. Terrs.," F. V. Hayden, vol. iii.

(=Orohippus Marsh) to Anchitherium of the family of the Palæotheriidæ. The transition is seen in some genera of the intermediate family of the Chalicotheriidæ, beginning with Ectocium (Cope).

FIG. 10. *Hyrachyus agrarius* Leidy, superior molar teeth, natural size; from Bridger bed of Wyoming. From Leidy, "Report U. S. Geol. Surv. Terrs.," F. V. Hayden, vol. i.

Three species of Systemodon are known, all from the Wasatch Eocene. The largest, *S. tapirinus* Cope, was equal to a large ram. A dozen species of Hyracotherium are known from the Eocene of Europe and North America, which range in size

from that of a sheep to that of a kit-fox. Several species of Helaletes have been described from the Bridger Eocene. The species of Hyrachyus are rather numerous, and range through

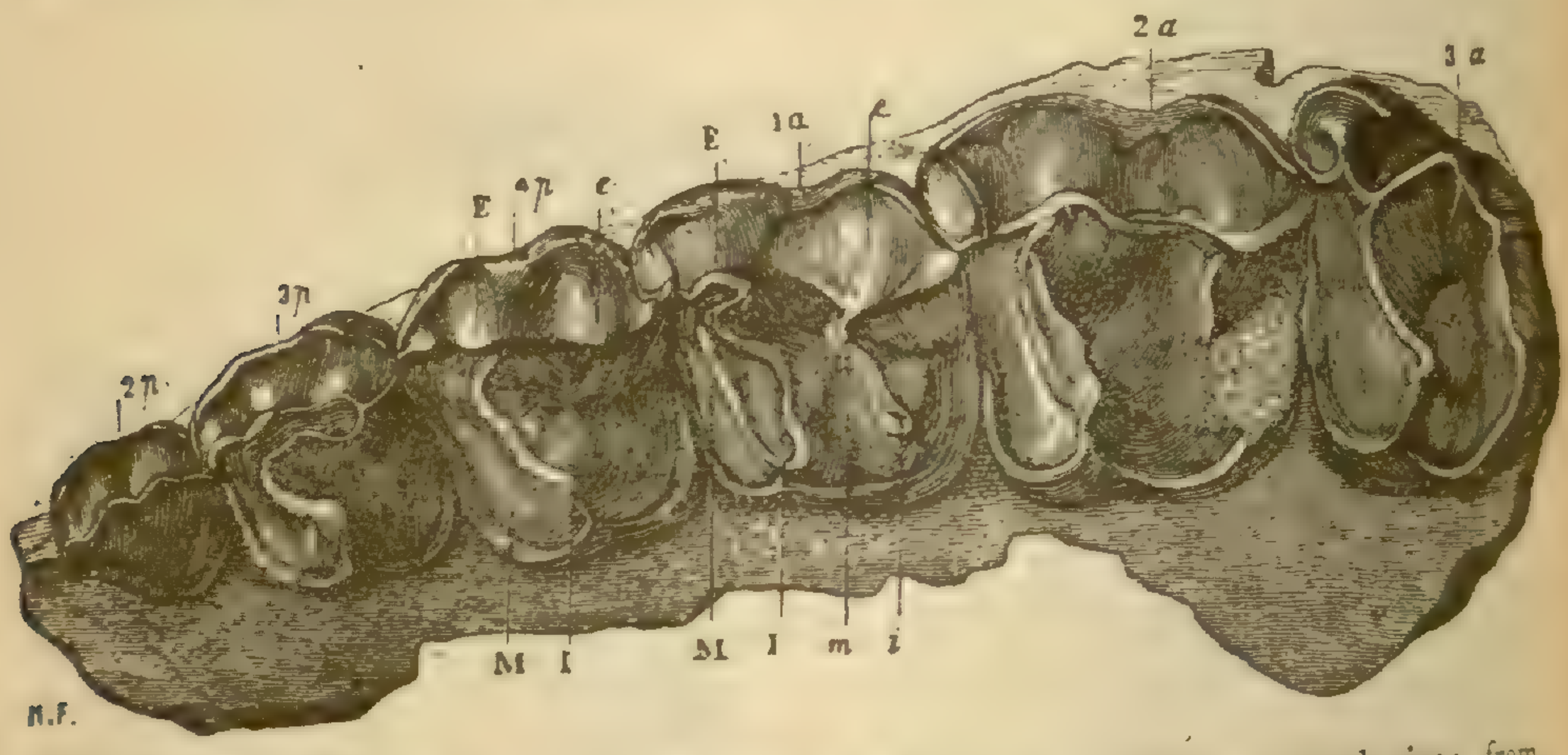


FIG. 11. *Lophiodon isselensis*, superior molars three-fifths natural size; from Middle Eocene of France. From Gaudry, "Enchainements du Régne Animal."

the Wind River, Bridger, and Diplacodon beds. Dilophodon has two species and Colonoceras one species, in the Bridger. Lophiodon is, so far as yet known, confined to Europe. One of its species, *L. rhinoceroides*, was as large as a medium-sized rhinoceros, and several species ranged in dimensions to those of a sheep. They appear in the Bruxellian, and range upwards through the Bartonian. Heptodon is, so far, only American; two species, a large and a small, are found in the Wasatch formation, and two, of intermediate size, in the Wind River.

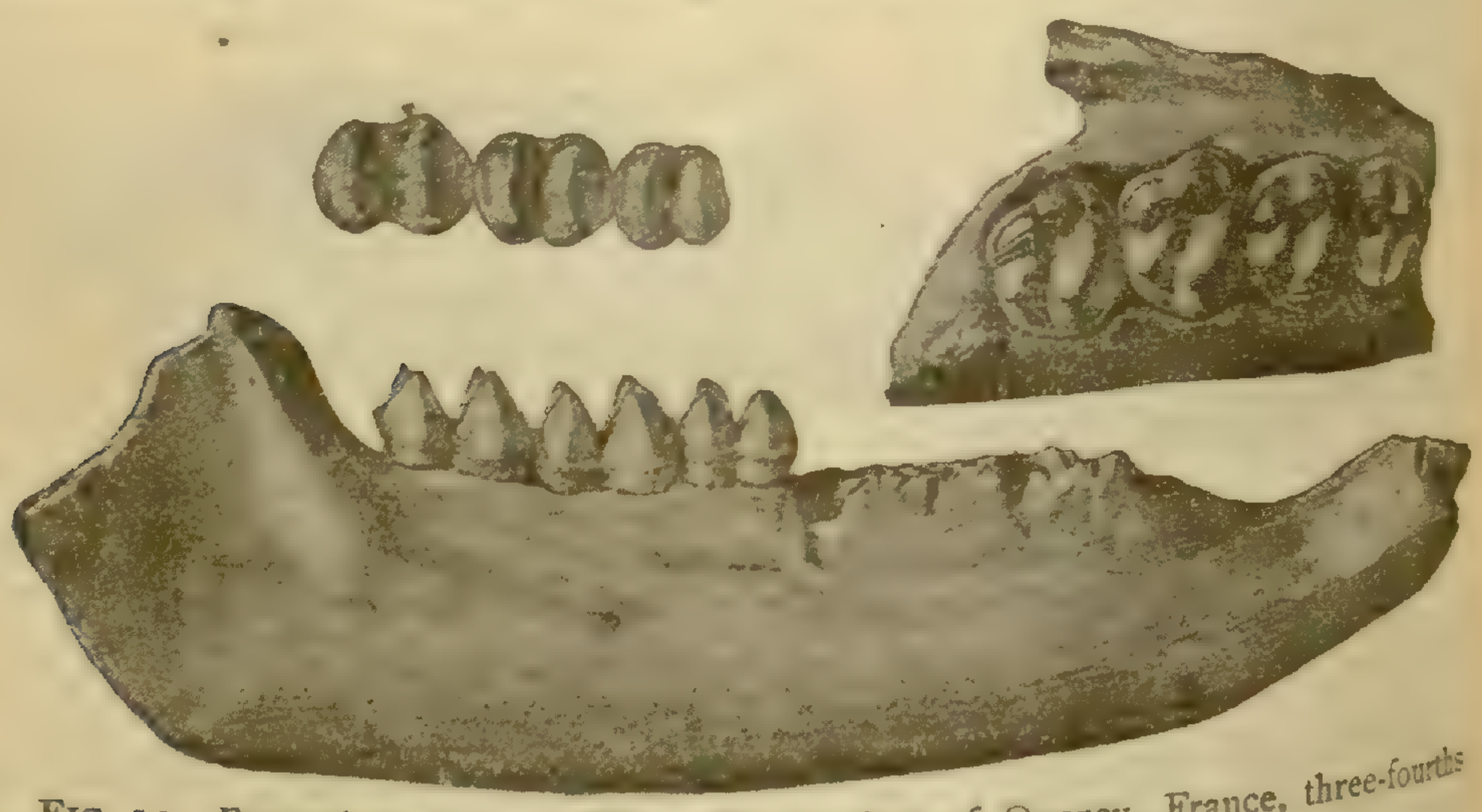
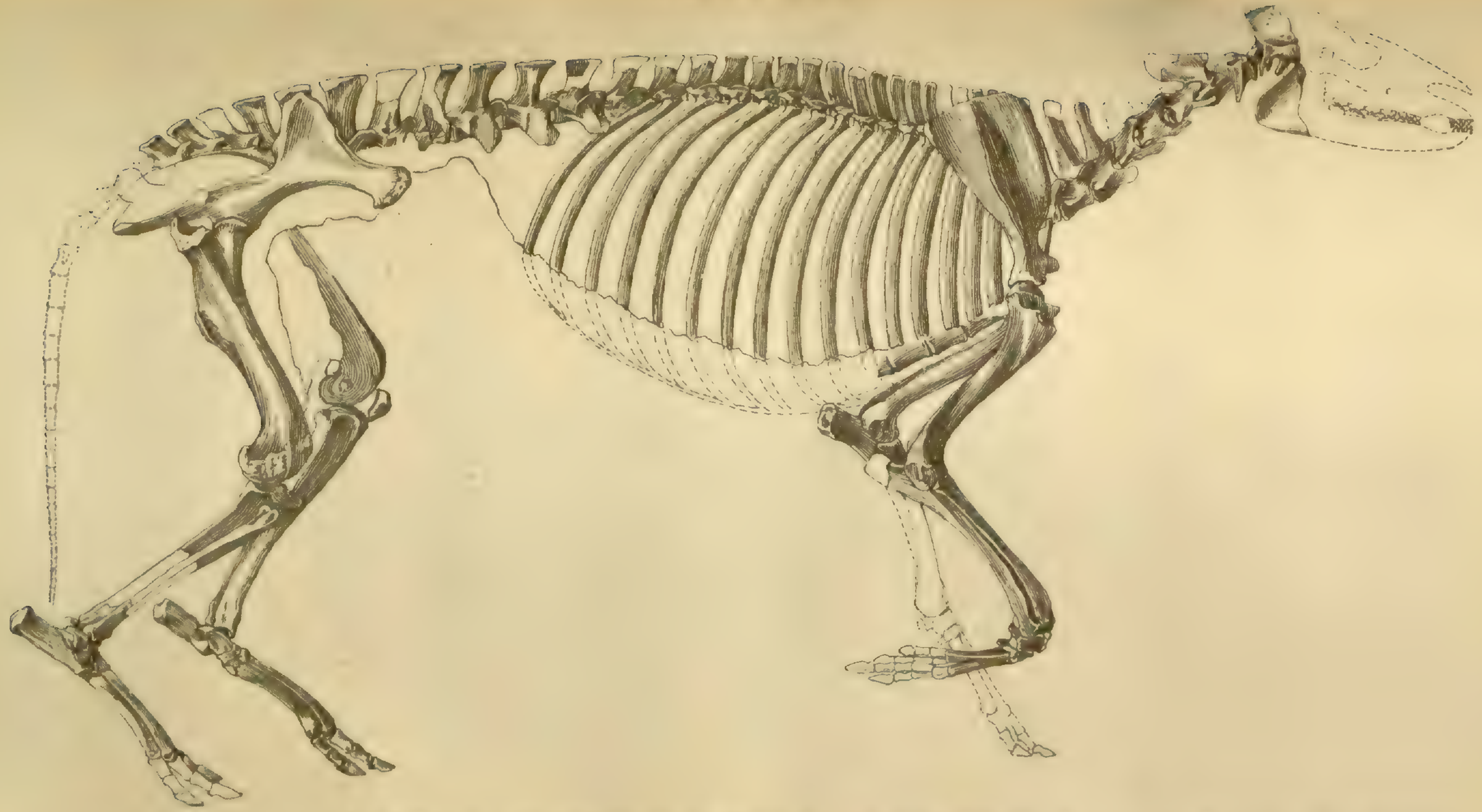


FIG. 12. *Protapirus priscus* Filh., Phosporites of Quercy, France, three-fourths natural size. From Filhol.

Protapirus is from the Phosphorites of France; and Isecto-



Hyrachyus agrestis, Leidy, $\frac{2}{15}$ natural size; from Bridger bed of Wyoming. Unshaded portions not preserved. Original, from specimen in Coll. E. D. Cope.

lophus is from the summit of the Eocene in North America, or from the Diplacodon beds.

As but one genus of TRIPLOPODIDÆ is known, its origin and probable descendants only can be referred to. It may very readily have been derived from Heptodon, with which it agrees in dental formula. The loss of the heel of the last inferior molar and of the fifth anterior digit would metamorphose Heptodon into Triplopus. Two species are known, both from the upper division of the Bridger Eocene. A possible third species is from the Diplacodon bed (*Prothyracodon* S. and O.).

FIG. 13. Skull of *Triplopus cubitalis* Cope, from the Bridger Eocene of Wyoming, three-quarters natural size; right side. Original; from the "Report U. S. Geol. Surv. Terrs.," vol. iii. Fig. *a*, superior molars with deciduous premolars; *b*, third and fourth superior premolars.

The CÆNOPIDÆ include genera which have lost the superior canine teeth, and have thus come to resemble the rhinoceroses. The known genera resemble these animals also in the reduction in the number of the incisors, and in one genus at least a dermal horn was present. The two genera known differ as follows:

No dermal horn;.....*Cænopus* Cope.
A dermal frontal horn;.....*Dihoplus* Brandt.

This family constitutes the transition between the Lophiodontine group of the Lophiodontidæ by Heptodon or Hyrachyus,

and the Rhinocerontidæ. Cænopus embraces, as yet, only American species, of moderate and small size; the *C. occidentalis* Leidy had four toes in front and three behind, representing the type which is the phylogenetic ancestor of the lowest and only four-fingered genus of Rhinocerontidæ, Aceratherium. A cusp is sometimes present within the inner extremity of the incurved, transverse crest of the premolars in Cænopus. Fusion of this with the transverse crest has produced the double transverse crests of the premolars of the Rhinocerontidæ. Dihoplus must be regarded as a collateral outgrowth from Cænopus. It is represented by one European species, the *D. schleiermacheri*, which is of larger size than either of the known species of Cænopus.

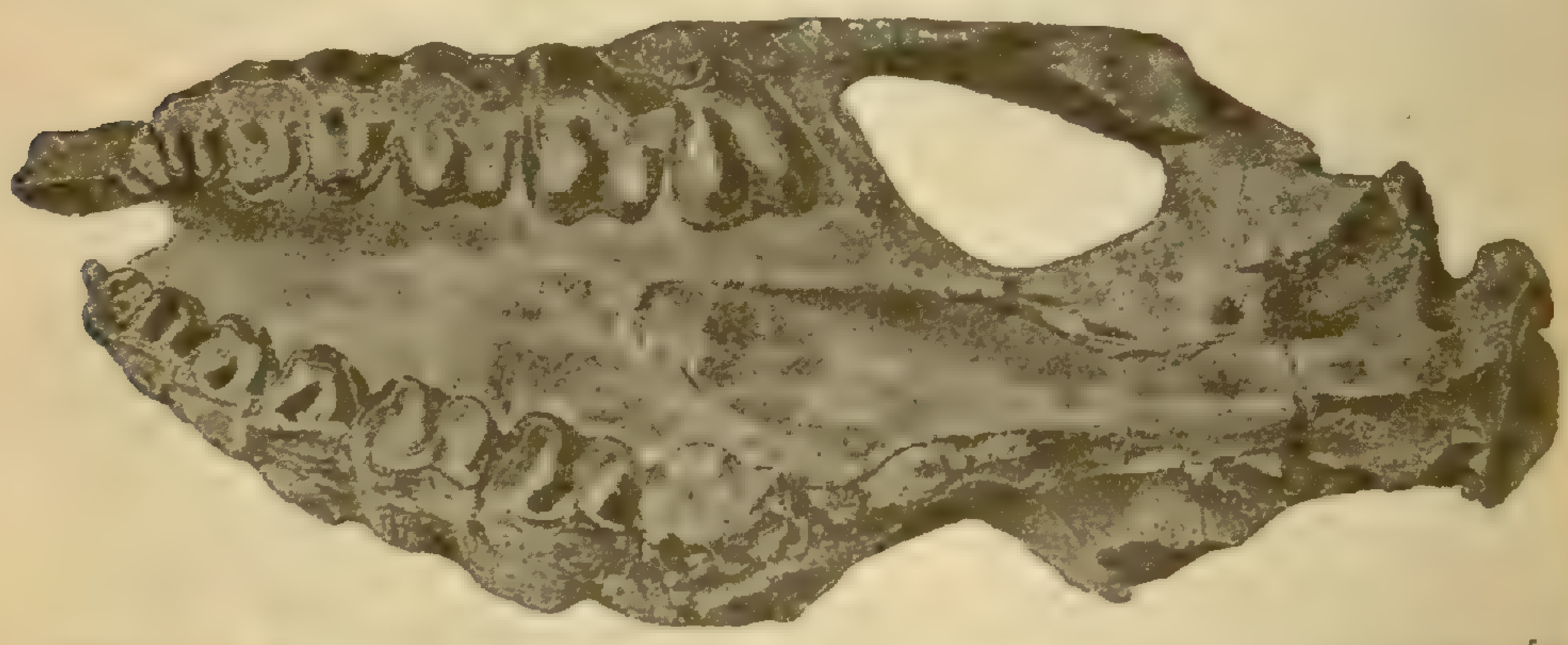


FIG. 14. *Cænopus occidentalis* Leidy; cranium, one-fourth natural size, from below; from the White River Miocene of Nebraska. From Leidy, "Ancient Fauna of Nebraska."

In the HYRACODONTIDÆ we have a direct descendant from the Lophiodontidæ, but presenting a modification quite different from the Cænopidæ. In that family the canines were lost and the simple premolars retained; in the present family the canines are retained and the premolars become complex, as in the rhinoceroses. Three, perhaps four, genera are known:

I. Canines very distinct from incisors.
Premolars $\frac{4}{4}$; ..... *Amynodon* Marsh.
Premolars $\frac{3}{2}$; ..... *Metamynodon* S. and O.

II. Canines small, similar to incisors.
Premolars $\frac{4}{4}$; ..... *Hyracodon* Leidy.

These genera are all hornless.

Amynodon is the oldest and ancestral genus; its two species belong, one in the Diplacodon formation, and the other in the Bridger. Desmatotherium (Scott) belongs here, but I do not

know how to separate it from Amynodon. Metamynodon and Hyracodon are from the White River Miocene. The family is not yet known from higher formations, and appears to have died out. Why such a robust and well-defended type as Metamynodon should have disappeared, and the comparatively weak and entirely unarmed Cænopus should have survived, is not easy to understand. In Hyracodon we observe a degeneracy of the anterior dentition of both jaws. According to Scott, *Hyracodon nebrascensis* was "a slender, long-limbed, and slightly-built animal, with a long neck." Three or four species only are known. The entire family is, so far, only known from North America. The phylogeny may be thus represented:

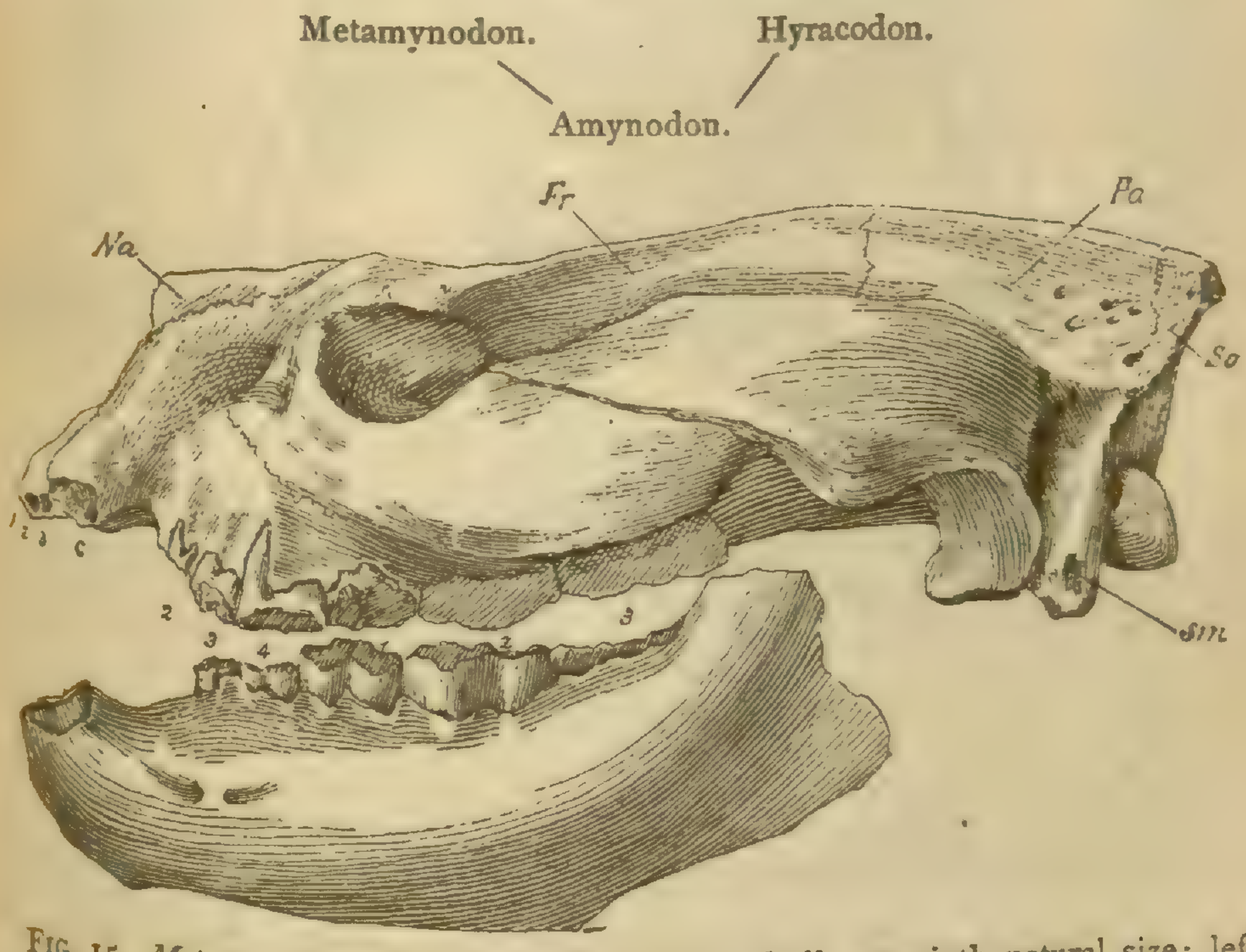


FIG. 15. *Metamynodon planifrons* S. and O.; skull, one-sixth natural size; left side. From Scott and Osborn, in "Bulletin of Mus. Compar. Zoölogy Cambridge."

The RHINOCERONTIDÆ came into existence in the Miocene of Europe, in a genus nearer to the Cænopidæ than any other of the family. This approximation is shown in the persistence of the external or fifth digit of the anterior foot in the genus Aceratherium (Kaup.). In this form all the superior premolars have the structure of the true molars; so that it enters the present family. The general relation of the component parts of the true molars in the rhinoceros family is that of the Lophiodontidæ in all important respects. The external ends of the cross-

crests of the inferior true molars are generally turned forwards and inwards, showing a tendency to the formation of V's.

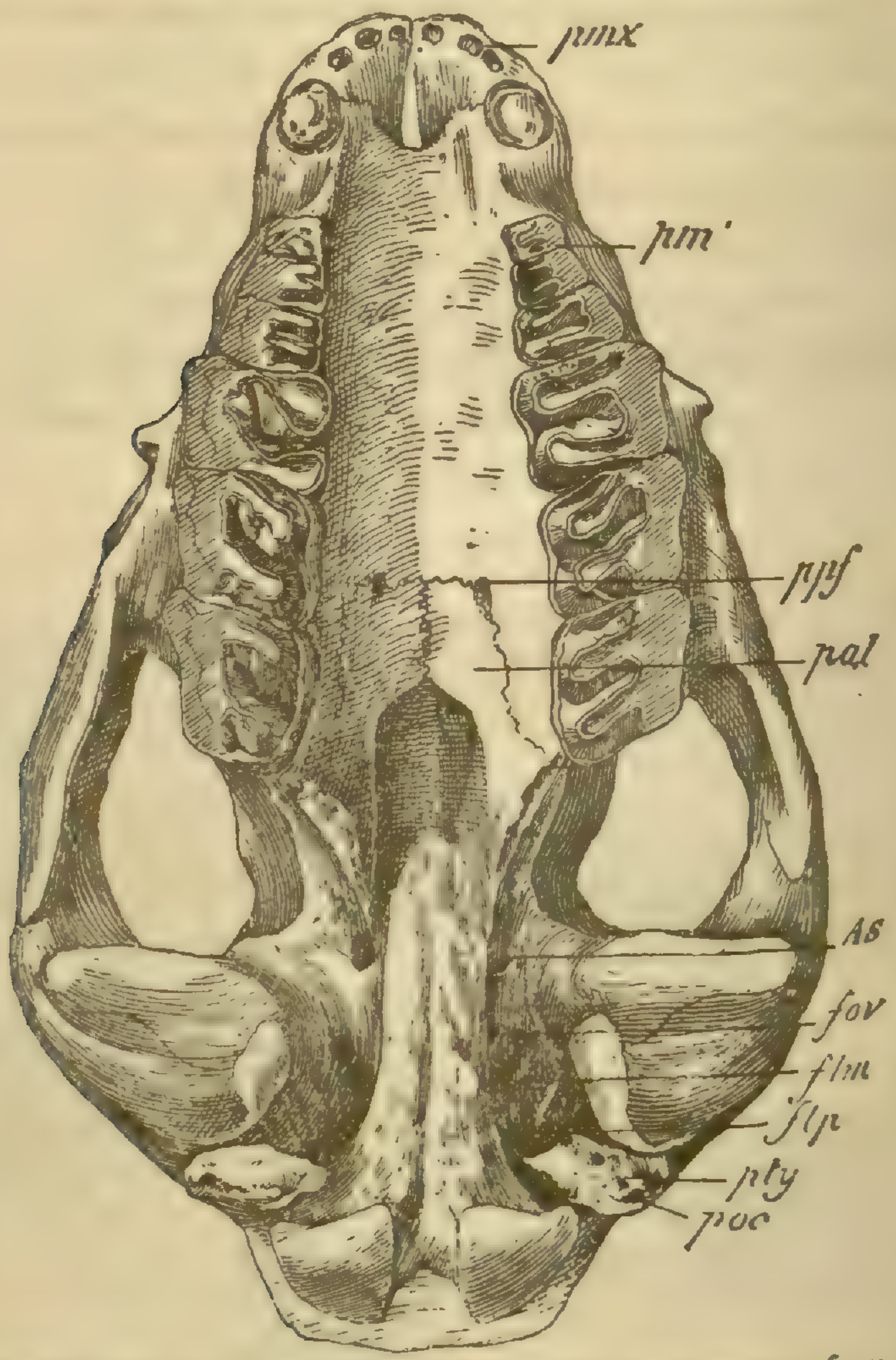


FIG. 16. *Metamynodon planifrons* S. and O.; the same cranium from below; from White River bed of Nebraska. From Scott and Osborn, in "Bulletin of Mus. Compar. Zoölogy Cambridge."

The changes in the structure of the genera of this family are seen in the loss of incisor teeth, of the fifth digit from the anterior foot, and in the greater co-ossification of various bones of the skull,—among them of the nasal bones,—to support the offensive dermal horns. In Cœlodonta and Elasmotherium the nasal bones are further supported by the ossified nasal septum, and the last-named genus adds an osseous basis or even core for a horn on the frontal bone. In most of the genera the cross-crests of the superior molars are comparatively simple, but in Atelodus and Cœlodonta they display projecting angles, which, on wearing, join each other. In this way the valleys become surrounded or enclosed. This is especially the case

with the extinct genera of the Old World, Cœlodonta and Elasmotherium. In the latter the molars became prismatic, and the vertical enamel-plates vertically plicate.

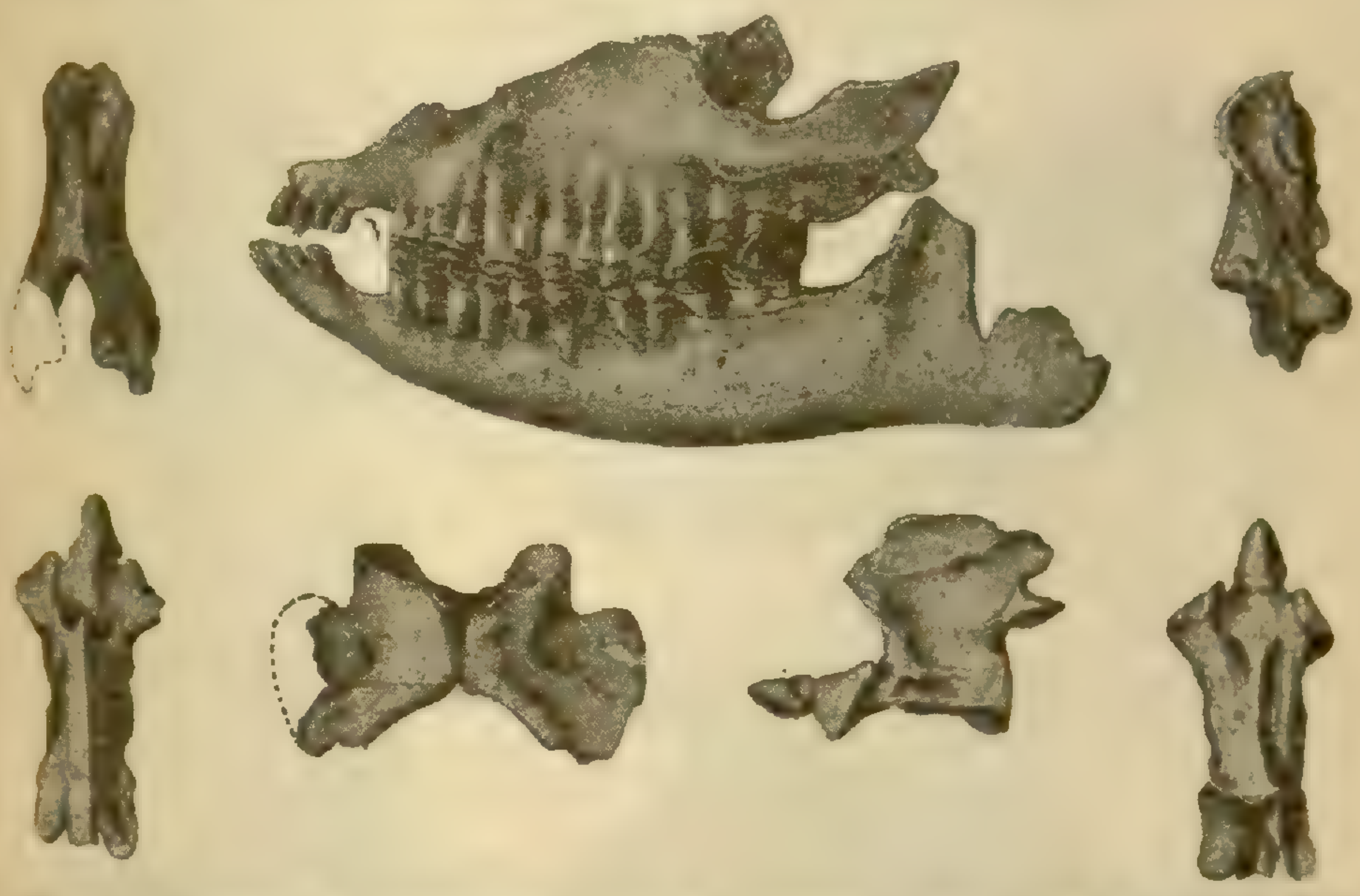


FIG. 17. *Hyracodon nebrascensis* Leidy, cranium, four-fifteenths natural size; left side of facial region and lower jaw; occipital and mastoid regions from behind and from side; and atlas and axis, the latter from above, side, and below; from White River Miocene of Colorado. Original.

This line first appears in Europe, and in Europe, Asia, and Africa it reached its highest specialization and force, in two lines. The one terminated in the genus Rhinocerus, of which two species now exist in Asia. The other line first appeared in the upper Miocene of Europe and India, in the genus Atelodus, of which two species still exist in Africa. From this the genus Cœlodonta took its origin, and peopled the temperate and cold regions of Europe and Asia. This form gave rise to Elasmotherium, which was the largest and most remarkable of all the Rhinocerotidæ. Its only known species, *E. typum*, dwelt in the cold regions of Europe and Asia.

In North America it developed only two genera, Aphelops[1] and Diceratherium, the former in the Loup Fork, the latter in the John Day, Miocene ages. Both were numerous in individuals. Aphelops did not develop a horn. Diceratherium developed two opposite tuberosities on the nasal bones, which probably supported dermal callosities.

[1] For an illustrated account of this genus, see NATURALIST, 1879, p. 771, *a*.

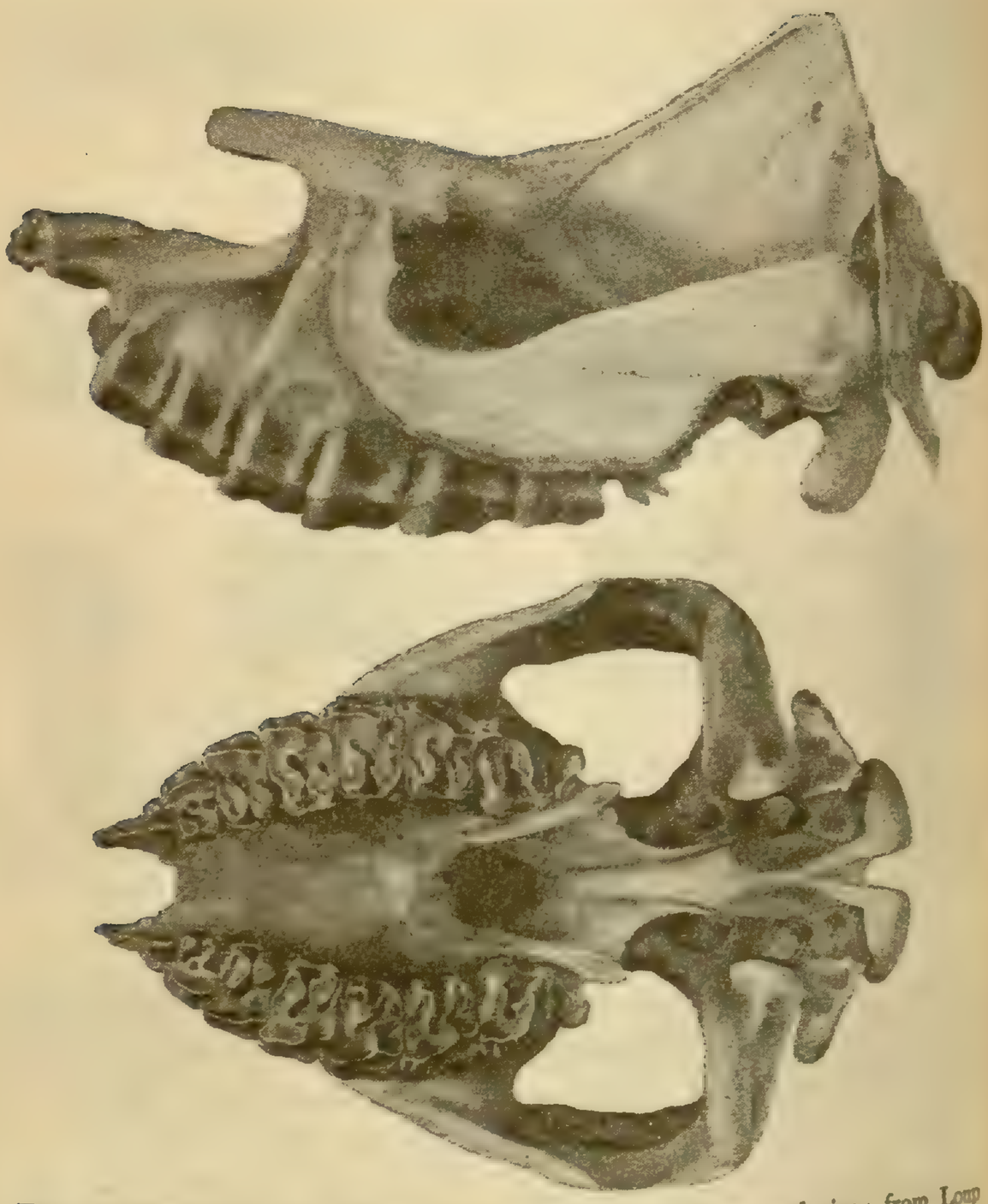


FIG. 18. *Peraceras superciliosus* Cope, about one-sixth natural size; from Loup Fork bed of Nebraska. Original. Fig. *a*, left side; *b*, from below.

A. Four anterior digits.

Incisors $\frac{2}{1}$; canine $\frac{0}{1}$; no horn; posttympanic bone distinct;..*Aceratherium* Kaup.

AA. Three anterior digits.

a. Posttympanic process not coossified with postglenoid.

Incisors $\frac{1}{1}$; canines $\frac{0}{1}$; no dermal horn; .....*Aphelops* Cope.

Incisors $\frac{0}{1}$; canines $\frac{0}{1}$; no dermal horn; .....*Peraceras* Cope.

Incisors $\frac{1}{1}$; canines $\frac{0}{1}$; a tuberosity for a dermal thickening on each nasal bone;.....*Diceratherium* Marsh.

Incisors $\frac{1}{1}$; canines $\frac{0}{1}$; a median dermal nasal horn;.....*Ceratorhinus* Gray.

Incisors $\frac{0}{0}$; canines $\frac{0}{0}$; dermal horn median; no osseous nasal septum;.....*Atelodus* Pomel.

aa. Posttympanic process coossified with postglenoid;

β. **No median frontal horn-core.**

Incisors $\frac{1}{1}$; canines $\frac{0}{1}$; dermal horn median; nasal septum not ossified;.....*Rhinocerus* Linn.

Incisors $\frac{0}{0}$; canines $\frac{0}{0}$; dermal horn median; nasal septum ossified;.....*Cælodonta* Bronn.

$\beta\beta$. A frontal median horn-core.

Molars prismatic;.....*Elasmotherium* Cuv.

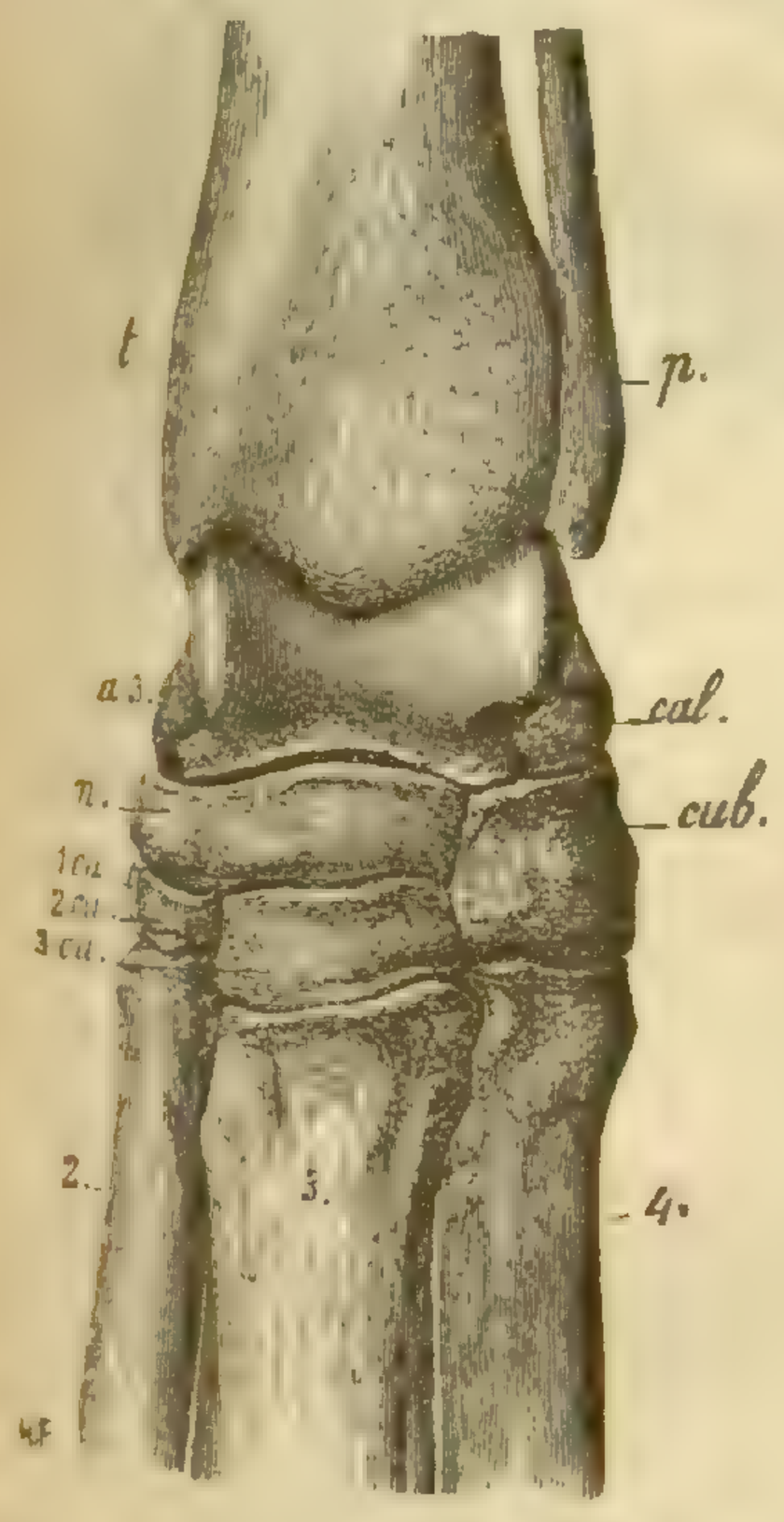


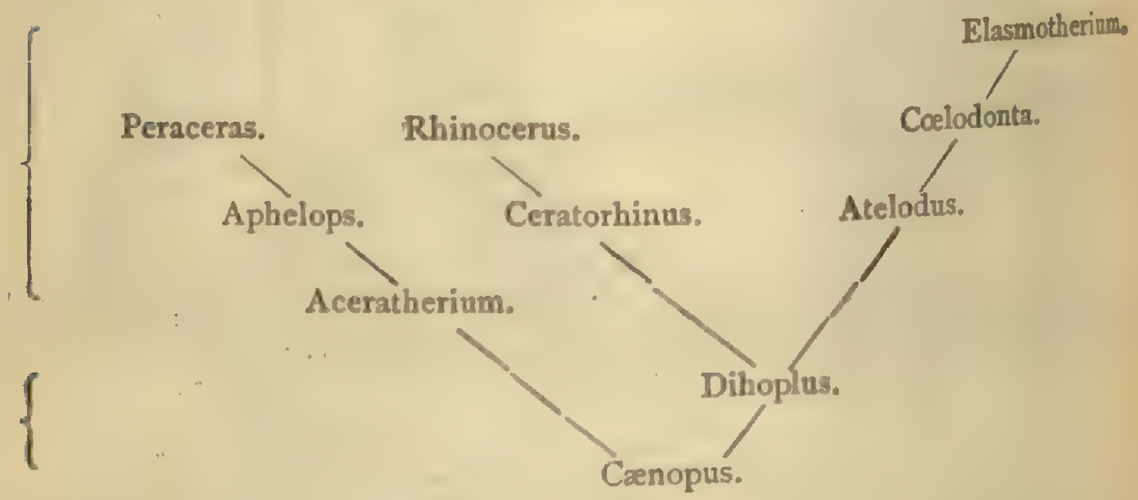
FIG. 19. *Atelodus pachygnathus* Wagn., left tarsus, one-fourth natural size, showing three posterior digits; from the Upper Miocene of Greece. From Gaudry.

FIG. 20. *Aceratherium tetradactylum* Lart., anterior foot minus the first row of carpal bones, one-fourth natural size, front; from Miocene of Sansan, France. After Gaudry; in Les Enchainements du Régne Animal.

The phylogeny of the rhinoceroses may be represented as follows:

FIG. 21. *Aceratherium incisivum* Cuv., skull, one-seventh natural size; from the Miocene of Epplesheim, Germany. From Gaudry, after Kaup.

FIG. 22. *Aphelops fossiger* Cope, skull, one-fifth natural size, from side and below; from Loup Fork beds of Kansas. From Marsh.



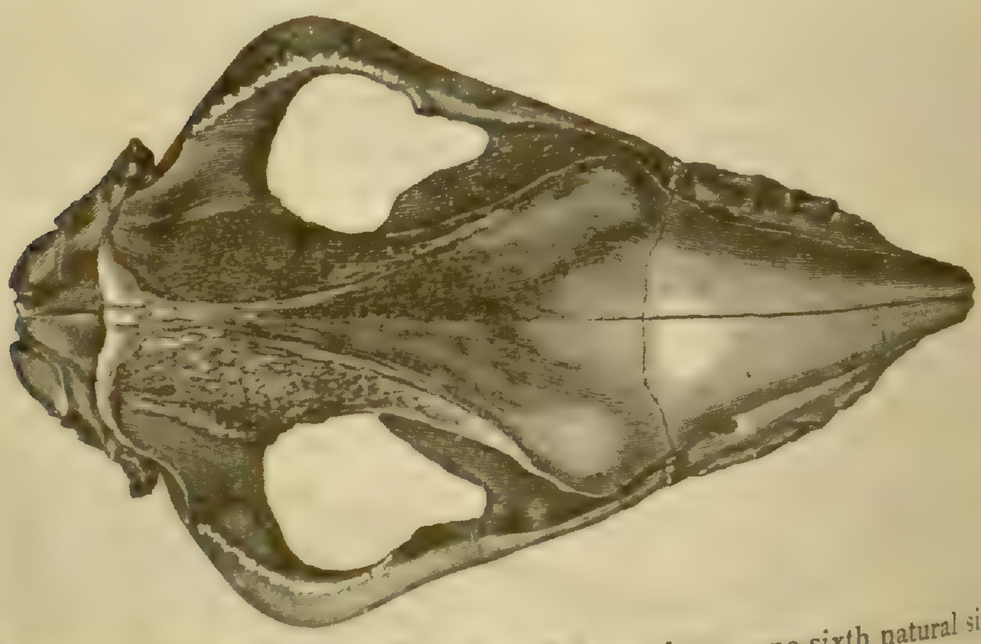


FIG. 23. *Aphelops megalodus* Cope, skull from above, one-sixth natural size. From the Loup Fork bed of Colorado; original.

The history of the TAPIRIDÆ has been mainly unravelled by Scott. Their origin from the Protapirine division of the Hyra-cotheriinæ cannot be doubted, but the intermediate forms have been mostly lost. The oldest genus appears in the Lower Mio-cene of North America (White River), and it is followed by

Tapiravus (Marsh) of the Upper Miocene. Tapirus is first found in the Upper Miocene of Germany (Epplesheim). The recent species of the family belong to Tapirus L., and Elasmognathus (Gill).

The three genera are distinguished as follows:

Two superior premolars different from true molars;.. *Tapiravus* Marsh.
One superior premolar different from true molars;
no heel of third inferior molar; nasal septum
cartilaginous;..... *Tapirus* L.
Like *Tapirus*, but nasal septum osseous;..... *Elasmognathus* Gill.

The order in which these genera stand above, represents their phylogenetic as well as their taxonomic relations, the oldest genus standing first.

(To be concluded.)

EDITORS' TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

To discover the relation of mind to matter is the goal of scientific research, and every addition to knowledge may be regarded as a contribution to this subject. The advent of Neo-Lamarkianism brings the question immediately within the view of the student of natural history, where it belongs, and brings it out of the metaphysical limbo, where it has so long lain neglected by science. The evidence that the environment is not the only factor in evolution is abundant enough, and the attempt to restrict the remaining factors to "heredity" has not long satisfied the mind of science. The evidence that the movements of animal organs and tissues is the other factor, constituting the source of heredity, is becoming clearer and clearer. The relation of sensation (consciousness or mind) to motion, is supposed to be well known, so that the direct dependence of evolution on the former seems to be an inference fully justified by the knowledge now in our possession.

But every step in this logical succession is, and ought to be, contested. It is denied by some that animal movements do materially affect animal structures. It is further denied that such

modifications if produced can be inherited. Since, however, it is admitted that mechanically-profitable variations do appear, and that they are inherited, the inquiry at this point is limited to the question whether the impacts, strains, torsions, flexures, etc., to which the parts of an animal are subjected by its motions do affect the structure or not. The final contest is, however, of a remarkable character. It is denied that the mental condition of an animal—*i.e.*, its sensations—has any influence in the determination of its movements. This proposition is apparently equivalent to the assertion that designed movements do not exist. An animal does not eat because it is hungry; it does not seek flight because it is frightened; it does not seek shelter because of temperature or storm; its voice is exerted without purpose, etc., etc. We imagine that it will be long before such an opinion can be sustained by any scientific evidence. Yet it seems to be the only alternative that is open to those who deny that consciousness is at the basis of evolution. It would seem to be the final *reductio ad absurdum* of that side of the question.

A brief statement of a discussion of these points referred to in the last NATURALIST is deferred to the December number, general notes, department Psychology.

THE appearance of the first number of Dr. Whitman's *Journal of Morphology* seems an event of sufficient importance in the history of American science to warrant more than a mere announcement. Several times have magazines been started which were fondly expected to play the same part in the United States that the *Quarterly Journal of Microscopical Science* does in England, but all have lamentably failed. Their editors have not succeeded in gaining the confidence and support of the best American workers. This rock Dr. Whitman has apparently escaped, and his first number, in variety of subject and breadth of treatment as well as in beautiful appearance, will compare favorably with any publication in the old world.

RECENT LITERATURE.

The Origin of the North American Flora.—The fifteenth report of the State Geologist of Indiana, issued in March of the present year, contains a long article on the "Origin of the Indiana Flora," by John M. Coulter and Harvey Thompson. The second part of the article, beginning on page 265, is on the "Origin of the North American Flora." It is so similar in many respects to an article published by myself in the *Journal of the Cincinnati Society of Natural History* in 1881, vol. iv., that I desire to call attention to it. I have arranged in parallel columns the parallel passages. The pages are those on which the similar passages are found. My article is entitled "On the Geographical Distribution of Plants Common to Europe and the Northeast United States."

Coulter and Thompson.

"In studying the flora of North America one cannot help being impressed with the fact of the identity of many of our genera, and even species, with those of Europe, and especially of Eastern Asia. In the number of identical species there seems to be a closer resemblance between the floras of Eastern United States and Eastern Asia than between the floras of the Eastern United States and the Pacific slope." P. 265.

"In addition to these 342 distinct species, [referring to a printed list which contains only 328 names] there are in our flora many varieties which are indigenous to Europe, and in Europe varieties very close to some in this country. Also there are many species in this country so very near European forms that no doubt they will eventually be considered the same species, or at least varieties. Indeed, Joseph F. James supposes that one-third of the species found in Gray's Manual resemble forms in Europe. When we take into consideration the fact that the Manual covers only a very small portion of North America, it is a natural inference that when the whole flora of North America is compared with that of Europe, there will be found many other species common to both." P. 269.

"It would be easy to account for this wide distribution of species if there were not so many facts to disprove the theory advanced by Meyen in 1846, that 'there is indeed nothing more easy to perceive, in the distribution of organic beings over the globe, than the universal law, that

James.

"Prof. Gray has made it well known that there is far more resemblance between the plants of the Atlantic coast of the United States and the Pacific coast of Asia than between the latter and the Pacific coast of America, especially of California." P. 67.

"The resemblance between the floras of Europe and the United States is by no means confined to the 360 identical species [given in several lists]. There are, besides, many closely related species, some of which may be reduced to geographical varieties. . . . If to the identical species we add these related and representative species, we shall find that one-third of the 2277 indigenous species given in Gray's Manual resemble European forms. But the similarity between the floras of North America and Europe is by no means confined to the small territory with which I have been dealing [the Northeastern United States]. . . . I have no doubt but that a comparison of the entire flora of the United States (excluding the semi-tropical one of California . . .) will show nearly as much resemblance as I have shown exists in the small territory here dealt with." P. 66.

"Scarcely any one now believes in the assertion of an eminent authority,* that 'there is indeed nothing more easy to perceive, in the distribution of organic beings over the globe,'" etc., etc. P. 51.

"* Meyen, Geog. of Plants. Pub. of Roy. Society, 1846, p. 265."

Coulter and Thompson.

nature, in similar circumstances, has always produced similar or perfectly the same creatures.'" P. 270.

. . . "We find the scientific thought of the day to be, as expressed by Alfred Wallace, that 'every species has come into existence, coincident both in space and time with a pre-existing, closely-allied species.'" P. 270.

"'Therefore, when we find identical species in two different quarters of the globe, we believe the individuals in both localities to be descended from a common parent.'" P. 271. [Quoted without reference.]

"Naturally we look to the north for this highway between the two continents [Europe and America]; for there is now very close connection with Asia on the northwest. . . . However, having evidence of former land elevation in high latitudes, or accepting Croll's theory in regard to the displacement of the earth's centre by a polar ice-cap, which would result in the ocean having a lower level in these latitudes in the Tertiary period than now, in either event the continental masses would be nearer together at that time, if not in actual connection." P. 271.

"As yet much of the region in the vicinity of the North Pole is unknown, but enough has been discovered to prove that there is much land within a short radius of the Pole." P. 271.

"Along with these forest-trees [sequoia, tulip, etc.] which have been preserved must have grown the shrubs and herbs which we now find coexisting with them in temperate climes." P. 272.

"As will be seen from the list of common plants given, about three-fifths of them are mountain and highland forms in the United States, and extend into Canada as lowland forms. About one-third are inhabitants of low sphagnous swamps and marshes, while the remaining small fraction might be called lowland species." P. 272.

"In North America, as these immense fields of ice moved southward they pushed all the original and introduced flora before them, forcing highland forms into lowlands, and all forms farther south." P. 273.

"Others survived in sheltered places and by very slow adaptation to climate and awaited changes, which should give them a broader field and more favorable circumstances for a better development.

James.

. . . "Wallace has expressed it, that 'every species has come into existence coincident both in space and time with a pre-existing, closely-allied species.'"† P. 51.

"† Wallace, Contrib. to Nat. Selec., N. Y., 1871, p. 5."

"Therefore, when we find identical species in two different quarters of the globe, we believe the individuals in both localities to be descended from a common parent." P. 51.

"We may very reasonably suppose that during the warm period at the north the ocean was at a lower level than it is now,‡ and that a land connection formerly existed between the northwest coast of America and the northeast coast of Asia."

"‡ In consequence of the withdrawal of large quantities of water to form the Antarctic ice-cap, and because the shifting of the earth's centre of gravity caused by this ice would have a tendency to draw the water toward the south, thus leaving much dry land at the north.—Croll, 'Climate and Time.'" P. 65.

. . . "The region close around the North Pole is, as yet, a *terra incognita*. We know enough of it, however, to say with certainty that there is considerable land clustered in its vicinity." P. 65.

"Innumerable herbaceous species, too, found suitable homes in the forests and plains of the north at that time." P. 54.

[The list given by Coulter and Thompson is not divided in any way, so it is not possible to see which are highland or lowland forms. But in my paper they are divided into "strictly alpine species," "sub-alpine and other species having a north or northwestern range," "species living either entirely in the water, or else in swamps, marshes, and wet places."] Pp. 56, 57, 60.

"With such a mass of ice covering the country, all animal and vegetable life must either have been destroyed or else forced to migrate southward toward warmer regions." P. 53.

"The few remaining [of list No. 1] may be forms which have been developed from others, on account of the struggle for existence which ensued when left on the mountains during their

Coulter and Thompson.

No doubt this gradual change, produced by an attempted adaptation to climate and surroundings, will account for many of the very nearly related species and varieties in North America and the Eastern Continent." P. 273.

"Hence we must conclude that our North American flora has originated in the far North, and once flourished around the North Pole; that it was driven south by the cold of the glacial epoch," etc. P. 274.

James.

return to the north, at the close of the glacial epoch." P. 57.

[I conclude] "2nd. That the species of plants common to Europe and America have had a common origin in the land about the North Pole.

"3d. That they have migrated south on account of the cold in the Arctic regions," etc. P. 67.

These passages will give an idea of the similarity in thought between the two articles. There is no reference in any place to my article, although the authors must have had it before them. I submit that it is only fair to refer to an article from which so many ideas have been gleaned.—*Joseph F. James, Miami University, Oxford, O.*, October 10, 1887.

Ridgway's Manual of Ornithology.[1]—In this book we have the result of the knowledge of one of our first ornithologists, Mr. Robert Ridgway, brought fully up to date. No one is more competent for the task, and the student as well as the sportsman may rely implicitly on the statements contained in this book. The descriptions are all arranged in key form. This method is adapted to the presentation of brief definitions, especially those of the higher groups. When it comes to the presentation of the numerous characters of species it becomes awkward from a typographical point of view, and we fancy from the appearance it gives this volume that it will not replace the usual full paragraph form of description for species. In the keys of genera we observe with gratification that definitions are rarely based on color characters. The nomenclature is also thoroughly cleared up, and the results are a warning to all careless renamers. We regret, however, to observe that the author adheres to the practice of giving two identical names to a species, when the species name has been adopted for that of a genus. The result is a tautological absurdity. The references to exotic ornithology are one of the valuable features of the book.

Synopsis of the Flora of the Laramie Group.[2]—In this important paper Mr. Ward gives a general view of the subject in question, which embraces a total of 1540 species. "Of these

[1] A Manual of North American Birds, by Robert Ridgway. Illustrated by four hundred and sixty-four outline drawings of generic characters. Philadelphia: J. B. Lippincott Co., 1887.

[2] From the Annual Report U. S. Geol. Survey of the Territories, 1886, p. 400. By Lester F. Ward.

286 are Cryptogams and 1254 are Phanerogams. The Cryptogams are 119 cellular and 167 vascular, and the Phanerogams are 125 Gymnosperms and 113 are Angiosperms. The Angiosperms embrace 467 apetalous, 406 polypetalous, and 106 gamopetalous species." The comparison that is made between this flora and that of the Cretaceous systems below, and the Eocene above, is highly instructive. It is well known that the students of palæobotany have insisted that the evidence throws the Laramie into the Eocene series, while the cultivators of the palæontology of the Vertebrata have been equally certain that this system must be placed at the summit of the Cretaceous. The specialists in Invertebrata have not produced very strong evidence either way. It is therefore a matter of much interest that Mr. Ward, after this full survey of the flora, writes as follows: "Taking all these facts into consideration, therefore, I do not hesitate to say that the Laramie Flora as closely resembles the Senonian Flora as it does either the Eocene or the Miocene Flora. But again, I would insist that this does not necessarily prove either the Cretaceous age of the Laramie Group or its simultaneous deposit with any of the upper Cretaceous beds." To the palæontologist the above paragraph will be sufficient to settle finally the reference of the Laramie to the Cretaceous series, without regard to the question of synchronism. We are not fully acquainted with the true time-relations of the extinct floræ and faunæ of the northern hemisphere, but we have evidence enough to show that, whether exactly synchronous in different parts of this area or not, the nonconformity in time has not been very great.

The memoir is accompanied by numerous illustrations.—*E. D. Cope.*

Keep's West Coast Shells.[1]—This is a popular work of convenient size for the pocket, and on a subject which is interesting to every lover of nature. With its help the student may identify the species in their haunts, not by a system of scientific analytical keys, but by the aid of excellent wood-cuts, and appropriate descriptions of their external characters. As a book for the amateur, and as introductory to a more severe scientific treatment of the subject, this book is admirably adapted.

Batrachians and Reptiles of Central America and Mexico.—In this Bulletin (No. 32) of the United States National Museum Prof. E. D. Cope has published a synonymic and geographical catalogue of the animals referred to in the title. The

[1] West Coast Shells. A Familiar Description of the Marine, Fresh-Water, and Land Mollusks of the United States found west of the Rocky Mountains. By Josiah Keep, A.M. San Francisco: Bancroft Bros. & Co., 1887.

richness of the region in question is shown by the fact that they number in total 705 species, which are divided among 197 genera. Of the 705, 135 are Batrachia and 570 are Reptilia. Of snakes there are 315 species, of which 45 are venomous. The family of Colubridæ alone contains 243 species. The other families, which include over twenty species, are (snakes) Crotalidæ; (lizards) Scincidæ, Anguidæ, Iguanidæ, Anolidæ; (frogs, etc.) Cystignathidæ, Hylidæ, and Bufonidæ. Three new genera are described: Diaglena for the *Triprion spatulatus* of Günther; Dipeltophis for the *Leptognathus albocinctus* of Fischer; and Ophryacus for the *Atropus undulatus* of Jan. Two new species are described, *Scytopis boulengeri* and *Elaps bernadi.*

This Bulletin is an illustration of the delays of the United States Government printing-office. Handed in to the secretary of the Smithsonian Institution January 16, 1886, it is not published until October 16, 1887.

Illustrations of Vivisection.[1]—The errors of the antivisectionists have been so often set forth that it would seem unnecessary to repeat them, especially in view of the fact that the society that issues this pamphlet did at one time restrict its efforts to the very proper restraint of unnecessary and needlessly cruel vivisection. But in reprinting extracts from the papers of that irrepressible and irrational lady, Miss Frances Power Cobbe, the society lays itself open to a repetition of all the just complaints made against their movement by the science of the day. Dogs and rabbits strapped to holders in awkward positions may excite the sympathy of the ignorant, just as a horse on his back in the street may do, but appeals by such means to the sympathies of enlightened people will only excite a smile. Even less elegant and æsthetic are the scenes daily witnessed on the operating-table of the surgeon, but men and women submit to them for the good of themselves and of their families. The superstition that a muscular spasm necessarily produces pain is here played upon, and various operations are depicted, most of which are painless. In the infliction of suffering, however, which accompanies some of the physiological experiments, the humane scientific man takes no more pleasure than the antivivisectionist. He is only sustained in it by the knowledge that the benefit to mankind overbalances the suffering inflicted on the animal. This pamphlet is one of the illustrations of one of the noblest of human qualities gone wrong.

[1] Illustrations of Vivisection, or Experiments on Living Animals, from the Works of Physiologists, namely, Claude Bernard and Paul Bert, as reproduced in "Bernard's Martyrs" and "Light in Dark Places." By Miss Frances Power Cobbe. Philadelphia: American Society for the Restriction of Vivisection.

RECENT BOOKS AND PAMPHLETS.

Weismann, A.—Ueber die Zahl der Richtungskörper und über ihre Bedeutung für die Vererbung. Jena, 1887. From the author.

De Man, J. G.—Uebersicht der indo-pacifischen Arten der Gattung *Sesarma*, Say. Ext. Zool. Jahrb., 1887. From the author.

——Bulletins U. S. Geol. Survey, Nos. 34–39. From the Survey.

Shufeldt, R. W.—Contributions to the Comparative Craniology of the North American Indians. Ext. Jour. Anat. and Phys., 1887. From the author.

Farlow, W. G.—The Task of American Botanists. Ext. Pop. Sci. Mo., 1887. From the author.

Beddard, F. E.—Note on a New Type of Compound Eye. Ext. Ann. and Mag. N. H., 1887. From the author.

GENERAL NOTES.

GEOLOGY AND PALÆONTOLOGY.

Zittel's Manual of Palæontology.[1]—Professor Zittel's Manual of Palæontology has now passed beyond the Invertebrata, and in the present part it enters the Vertebrata. This work appears to me to be the best synoptical manual of the subject which has yet appeared. Its scope is more comprehensive than that of most works of the kind, and its contents are more nearly brought up to the present date. In illustration it is especially meritorious, both in quantity and quality of figures. That the opportunities of its author are of the best, follows from the well-known excellence of the Museum of Munich; and his wide knowledge of the literature of the subject is displayed by the author at appropriate points in the work.

In the present part, the subject is completed as far as the end of the fishes usually enumerated under the name of Ganoids, which term, as is well known, includes all the palæozoic and many of the mesozoic forms. These, with the preceding sub-class of Selachii, are treated with much fulness of description and illustration. A great deal of information as to the structure of certain forms of these fishes is here brought together, information which has been hitherto largely inaccessible in America. The subject can be now intelligently studied here.

While we speak highly of most of the characteristics of this work, we cannot approve of the system in which the subject-matter is arranged. The inclusion of the Leptocardii and Cyclostomi among fishes is a distinct departure from the modern systems of classification, while the admission of a sub-class, "Ganoidei," is a concession to tradition rather than an expression of exact taxonomy. Then the inclusion of such forms as Pteraspis,

[1] Handbuch der Palæontologie. Herausg. v. K. A. Zittel, Prof. a. d. Univ. zu München, mitwirkung von Dr. A. Schenck. I. Abtheilung Palæozoölogie, III., vol. i. Lief. München u. Leipzig: R. Oldenbourg. 8vo.

Pterichthys, and Bothriolepis in this "sub-class" is certainly a violation of the precision of definition which all true systems should possess. Dr. Zittel says indeed of the Pteraspididæ that their position is entirely undecided. The "orders" of "Ganoidei" we find to be unnatural in various respects. We also object to the use of family terminations for orders, and ordinal terminations for families, which the authors of the work have adopted.

The fulness of this part of the subject as presented by Professor Zittel enables the reviewer to give a synopsis of his own views on the subject of the classification of the lowest Vertebrata, to which he has hitherto only contributed fragments.[1] This is now done in anticipation of a fuller memoir with complete illustrations.

Preliminarily, the following point, originally propounded in substance, I believe, by Professor Haeckel, is adhered to:

I. *No vertebrate which lacks the mandibular and scapular arches is a fish.*

On this account I have declined to include in the Pisces such forms as the Pterichthyidæ and Bothriolepididæ, also the Pteraspididæ and Cephalaspididæ, but have referred the latter of them to the Haeckelian class Agnatha, which also includes the Marsipobranchi, or lampreys. (See NATURALIST, 1886, 1027.)

II. *The primary divisions of fishes are indicated mainly by their cranial structure.*

This is an expression of the fact generally admitted by zoologists, that there are at least four primary divisions so defined,—viz., the Holocephali, the Dipnoi, the Selachii, and a fourth division, which was first named by Professor Sir Richard Owen, the Teleostomi.

III. *The divisions of the Teleostomi are indicated by fundamental modifications of their fin-structure.*

This taxonomic truth was first insisted on by the writer (*Transac. Amer. Philos. Soc.*, 1870, p. 445), and is now repeated with emphasis. The probably correct evolutionary view of Dohrn regards the fins as remains of three or four primitive longitudinal epiblastic folds, which have been supported by mesoblastic segments radiating from the central axis of the skeleton, and which have developed actinotrichia (mesoblastic, Ryder) within themselves, which have become ultimately correspondent, and articulated with, the internal mesoblastic segments, as fin-rays. I maintain that the phylogeny of the primary types of the Teleostomi will be found to be expressed in the successive stages exhibited by the process of the reduction of the internal bony

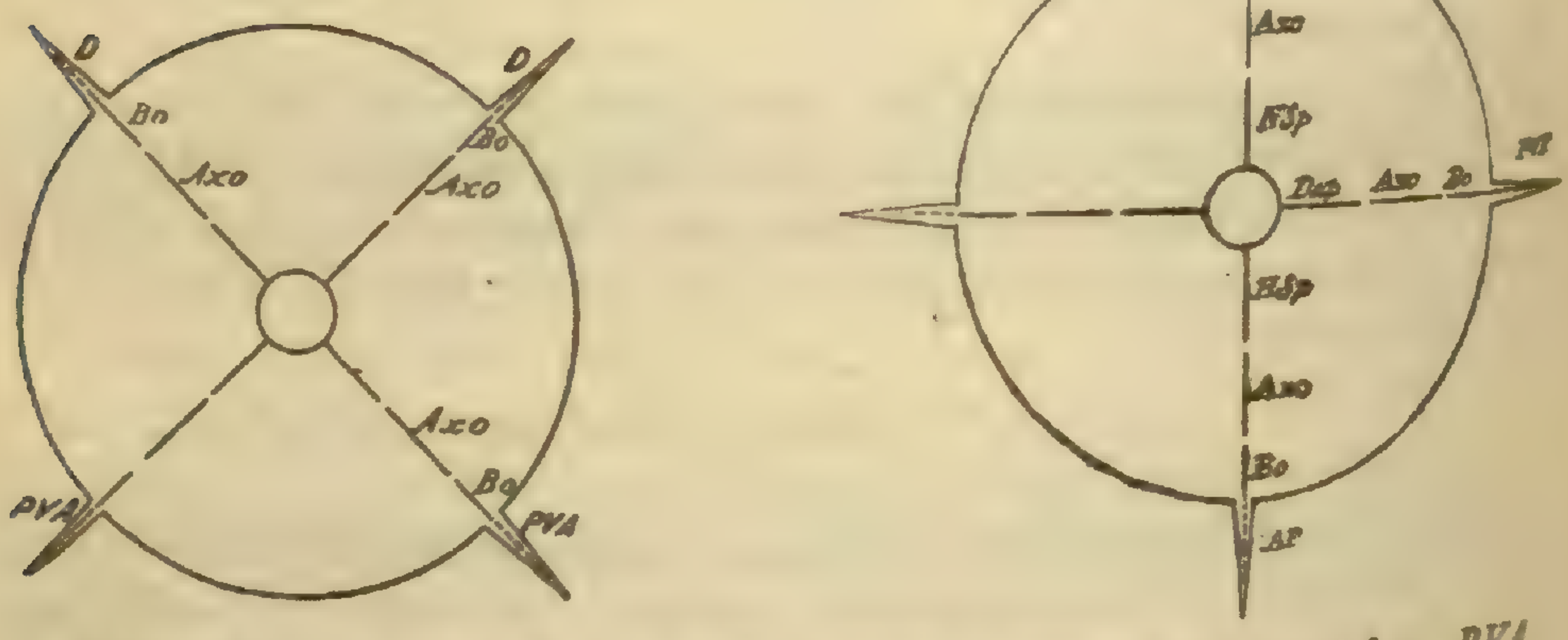
[1] Transactions of the American Philosophical Society, 1870, p. 445; "On the Classification of the Extinct Fishes of the Lower Types," Proceed. Amer. Assoc. Adv. Sci., 1878, p. 292; "On an Interesting Genus of Chordata," Naturalist, 1886, p. 1027.

supports of the external folds, to the proportions and positions which we behold them to present in the different groups of fishes.

IV. *The orders of fishes are defined by modifications of the skeleton of lesser significance than those included in statements II. and III.*

Under this head come modifications in the structure of the skull, vertebræ, and fins in which the multifarious character of fish evolution has displayed itself, and in which relation to the other classes of Vertebrata does not enter as an element of estimation.

In accordance with proposition III. I define what appear to me to be the primary divisions of the Teleostomi. Before doing so I will state the elements of the definition. The supports of all the fins consist primitively (in the case of the pectoral fins, the evidence is only partly in our possession) of at least three longitudinally connected osseous elements. These correspond to what have been named (1) the neural and hæmal spines of the vertebræ, (2) the axial segments[1] (interneural and interhæmal bones), and (3) the basilar segments[2] (so called because when present they are



EXPLANATION.—*D*, *DF*, dorsal fin; *PVF*, pectoral and ventral fins; *PVA*, pectoral, ventral, and anal fins; *AF*, anal fin; *NSP*, neural spine; *Dap*, diapophysis; *HSp*, hæmal spine; *Axo*, axonost; *Bo*, baseost.

the immediate supports of the fin-rays). I first used the terms axial and basilar for these segments (in 1870) as homologous in all the fins, a view which has been since adopted by the distinguished embryologist Ryder, who uses the following language (l. c., p. 985): "Regarding the whole of the mobile axial skeleton of the Lyrifera (= Pisces) as essentially homologous, I will call

[1] Proc. Amer. Philos. Society, 1877, May.

[2] Cope, Transactions Amer. Philos. Society, 1870, p. 445; Ryder, "The Origin of Heterocercy and the Evolution of the Fins and Fin-Rays of Fishes;" Report U. S. Fish Commission, 1886, pp. 985, 1017. The terms "actinost" (Gill) and "actinophore" (Ryder) were subsequently applied to the basilars.

the distal parts which directly support the true rays as *actinophores*." Those who prefer a substantive appellation for these elements may call them *axonosts* and *baseosts*. The only fin which does not present us with the series of three in some known type is the pectoral, though Tristichopterus (*teste* Traquair) may do so. The axonost is sometimes represented by more than one segment,—*e.g.*, Dipnoi, of which the proximal is the mesopterygium of Gegenbaur. It is accompanied in the Selachians by several other axonosts, which are equally in contact with the scapular arch. In Lepidosiren and Ceratodus it is not yet possible to determine how many of the pectoral segments belong to the axonost and how many to the baseost.

Next to the pectoral fin, the caudal presents us with the greatest divergence from the primitive condition; and next to it, the ventral fin departs most widely. The pelvic element so called is the axonost of this fin. The dorsal and anal fins depart less considerably from the type than any of the others, but the modifications are important, and have been mostly neglected in taxonomy. The following are the natural divisions represented by these modifications. They may be called superorders:

Dorsal, anal, pectoral, and ventral axonosts present, represented by a single element to each fin. *Rhipidopterygia.*

Dorsal, anal, pectoral, and ventral axonosts present; the dorsal and anal numerous, each articulating with a single baseost, if any; the pectoral axonosts present in variable number, articulating with numerous well-developed baseosts; the ventral axonost single, articulating with numerous baseosts; . . . . . *Crossopterygia.*

Dorsal and anal axonosts as in the last; no pectoral axonost, baseosts rudimental; a ventral axonost with numerous baseosts; . . . . *Podopterygia.*[1]

Dorsal and anal axonosts as in the last; pectoral axonost none, baseosts very few, small; ventral axonost present, with minute or no baseosts; *Actinopterygia.*[2]

The orders and families of these superorders appear to the writer to be as follows:

RHIPIDOPTERYGIA.

Baseosts present in dorsal and anal fins; . *Rhipidistia.*

Baseosts wanting to dorsal and anal fins. Caudal axonosts present, each one articulating with a neural spine (Huxley); . . . . . *Actinistia.*[3]

[1] Chondrostei, Owen, Cope, olim.
[2] Actinopteri, Cope, olim.
[3] Transac. Amer. Philosoph. Soc., 1870, pp. 450, 451.

CROSSOPTERYGIA.

A. Dorsal baseosts present.

Dermal rays (actinotrichia, Ryder) more numerous than baseosts; each axonost articulates with a neural spine; . . . . . *Haplistia.*[1]

Dermal rays equal in number with, and articulating with baseosts; . . . . . *Taxistia.*

AA. No dorsal baseosts.

Dermal rays equal in number with, and articulating with basilars; axonosts not articulating with neural spines; . . . . . *Cladistia.*[1]

ACTINOPTERYGIA.

I. Dermal radii more numerous (octinotrichia) than the baseosts and axials.

Intercentra distinct, small; . . . . . *Lysopteri.*[2]

II. Dermal radii equal baseosts and axonosts.

Vertebræ with distinct intercentra on the chorda dorsalis; . . . . . *Merospondyli.*

Vertebra with completed intercentra, which are amphicœl or annular; . . . . . *Isospondyli.*

Vertebræ with completed intercentra, which are opisthocœl; . . . . . *Ginglymodi.*

Vertebral column with completed intercentra and centra, both amphicœl; . . . . . *Halecomorphi.*

The other orders of the Actinopterygia and those of the Podopterygia are enumerated in my various papers on the recent fishes. Of the above, all are extinct excepting the Cladistia, the Isospondyli, Ginglymodi, and Halecomorphi. The families are the following. To the *Rhipidistia*, one family, the Tristichopteridæ. In it there is but one, a normal caudal fin, and the vertebræ are externally ossified. (Günther and Traquair.) The *Actinistia*, one family, the Cœlacanthidæ. In the latter there are two caudal fins, and the vertebræ are not ossified. The *Haplistia*, one, the Phaneropleuridæ (Zittel does not think this family Dipnoan as has been supposed). The *Taxistia*, two, the Cyclodipterini and Glyptodipterini, which should be called the Holoptychiidæ, and the Osteolepididæ. The *Cladistia*, one family, the Polypteridæ. The *Lysopteri*, one family, the Palæoniscidæ, from which the Platysomidæ is scarcely distinct. The *Merospondyli* embraces the Sauropsidæ[3] (= Microlepidoti and Cyclolepidoti, Zittel) and the Pycnodontidæ, with other families embracing more or less numer-

[1] Loc. cit. I endeavored (l. c.) to prove that the vertical spines supporting the finnules of Polypterus are basilars, but I do not now consider this view correct.

[2] Cope, Amer. Naturalist, 1880, p. 440; *Heterocerci* Zittel, 1887.

[3] Cope, Proc. Amer. Assoc. Adv. Science, 1878, p. 298, with the Lysopterous genera omitted.

ous genera, referred by Zittel to the families Stylodontidæ, Sphærodontidæ, and Saurodontidæ. Genera with annular intercentra, as Aspidorhynchidæ (Rhynchodontidæ, Zitt.), should be referred to the Isospondyli. Until the vertebral columns of the genera are better known, it will be difficult to decide which belong to the Merospondyli and which to the Isospondyli.

The Placodermi, after the exclusion of the Pteraspididæ, Cephalaspididæ, Pterichthyidæ, and Bothriolepididæ, form a homogeneous order. So far as the structure of the fins is known, it appears to belong to the superorder of the Actinopterygia,[1] but this is not fully established. If so, it appears to have the dorsal and anal fin-rays equal in number with the baseosts, and these to be equal in number and continuous with the axonosts (according to Von Koenen, in *Coccosteus inflatus*), characters not known in any other order of Actinopterygia. But one family is certainly known, the Coccosteidæ, which has a hinge-like articulation of the epiclavicular or clavicular plate with the cranium.

The descriptions and figures of Professor Zittel render it perfectly clear that the fishes rarely develop complete vertebral centra, the order Halecomorphi being the only example. The so-called centra of fishes are intercentra as in the Batrachia.[2] This is an important addition to the evidence of the affinity of these two classes of Vertebrata. It also shows that the mechanical origin of the rhachitomous vertebra in the fishes is the same as that which I have pointed out in the Batrachia, viz., as the effect of lateral flexures of the notochord on ossifications of the sheath. The Selachii have not experienced the rhachitomous stage, so far as yet known, because the primitive ossification has not been confined to the sheath of the notochord.—*E. D. Cope.*

A Saber-tooth Tiger from the Loup Fork Beds.—The White River and John Day Miocene formations in North America are well known to contain remains of saber-tooth cats of the family of Nimravidæ, while the Pliocene epoch has produced two species of saber-tooths of the family Felidæ. Hitherto the Loup Fork, or Upper Miocene formation, which intervenes between the John Day and the Pliocene, has produced no cats of this type. Under the circumstances it was to have been anticipated that they existed during this time, and I can announce that this supposition may be now exchanged for knowledge. A part of the mandible of a large cat has been in my possession for a considerable time, and I propose to describe the species it represents under the name of *Machærodus catocopis*.

Two characters first attract the attention; these are, first, the very large size of the inferior canine as compared with the in-

[1] See Naturalist, 1886, p. 1031, where it is provisionally referred to this superorder.

[2] See "The Intercentrum of the Terrestrial Vertebrata," Transac. Amer. Philos. Soc., 1886, p. 243, by E. D. Cope.

cisors; and, second, the slight development of the flange of the lower jaw. The angulation of the anterior part of the lower jaw is very well defined, but does not descend as a flange below the level of the inferior border. The anterior face is well distinguished from the lateral by the vertical angle, which is, however, obtuse. The form is quite similar to that in *Nimravus gomphodus*. The superior half of the anterior face is, in fact, deeply grooved on the middle line, a circumstance due to the large size of the canine and small size of the incisors. The latter are three in number, and the roots are much compressed, and so crowded as to alternate with each other. The crowns are lost. The canine is considerably compressed, and has a sharp serrulate posterior cutting edge, which descends to the base of the crown behind. There is no anterior cutting edge. The shape of a section of the tooth is lenticular, the anterior angle rounded off; the long axis extends a little oblique to the median line. The apex is lost. There are three foramina on one side, and two on the other of the median symphysis; and there are three mental foramina on the best preserved ramus.

Measurements.

	M.
Depth of symphysis	.068
Width of symphysis at middle	.031
Width of space between inferior canines	.028
Diameters inferior canine, antero-posterior	.020
Diameters inferior canine, transverse	.013

The large size of the inferior canine might lead to the inference that the superior canine is not so large as in the typical saber-tooths. It certainly exceeds in this respect the other known species. The small flange cannot sustain this inference, since it is similar in Nimravus, which has a large superior canine. The present species is the largest saber-tooth of North America, except perhaps the *Simlodon fatalis* Leidy. The specimen on which it is based was found by Frank Hazard in Phillips County, Kansas.—*E. D. Cope.*

Note upon the Genus Athrodon.—In a paper upon the "Structure and Classification of the Mesozoic Mammalia" (*Proceedings Philadelphia Academy*, June, 1887) I proposed the genus *Athrodon*, founded upon the maxilla referred to *Stylodon pusillus* by Professor Owen in his memoir upon the Mesozoic Mammalia. Professor Cope has kindly called my attention to the fact that *Athrodon* is preoccupied by Sauvage (*Bull. Soc. Geol.*, 1880, viii. p. 530) for a genus of Ganoid fishes. I therefore propose to substitute the term Kurtodon for *Athrodon* to embrace this genus of mammals.—*H. F. Osborn.*

MINERALOGY AND PETROGRAPHY.[1]

New Minerals.—*Langbanite* is the name applied by G. Flink[2] to a mineral which occurs in small black hexagonal crystals in a granular limestone at Långban, Sweden. In habit it is tabular or prismatic, with the prism faces but slightly developed. Its hardness is 6.5, specific gravity = 4.918. Its axial ratio is 1:1.6437. Its analysis yielded,—

Sb_2O_5	SiO_2	MnO	FeO
15.42	10.88	64.00	10.32

The discoverer regards it as silicate of manganese (Mn_5SiO_7) combined with antimonate of iron ($Fe_3Sb_2O_8$) in the proportions 37 : 10.——*Webskyite.*—This mineral, named by R. Brauns[3] after the late Professor Websky, of Berlin, is a decomposition product of the serpentine occurring in the paleopikrite of Amelose, near Biedenkopf, in Nassau. It occurs in black amorphous masses, with a bluish-green streak. Its hardness is 3 and its specific gravity 1.771. It is apparently isotropic in thin sections, where it possesses a green color. Its composition is as follows:

SiO_2	$Al_2O_3.Fe_2O_3$	FeO	MgO	H_2O	Loss at 110°
34.91	9.60	3.13	21.62	9.84	21.20

This corresponds to the formula $H_6R_4Si_3O_{13} + 6H_2O$, in which R = Mg and Fe.——*Laubanite* is described by Traube[4] as a new zeolite from the druses of the basalt occurring near Lauban, in Silesia. Its color is milk-white. It possesses a short columnar habit and a hardness of 4.5–5. It is found only in small crystals, implanted on phillipsite and other associated minerals. These crystals under the microscope are seen to be composed of little bundles of fibres. Its composition approaches very near to that of laumontite, from which it differs only in its percentages of calcium and water of crystallization.

Laubanite.	Laumontite.	Phillipsite.
$Al_2(SiO_3)_3$ $2Ca(SiO_3) + 6H_2O$	$Al_2(SiO_3)_3$ $Ca(SiO_3) + 4H_2O$	$3Al_2(SiO_3)_3$ $2Ca(SiO_3)$ $K_2(SiO_3) + 12H_2O$

Recent Investigations of American Minerals. *Mica.*—Prof. F. W. Clarke,[5] of the U. S. Geological Survey, has recently published an interesting paper in which the relations between three American iron-micas are discussed. The three micas in question are lepidomelane from Baltimore, Md., and from Litchfield, Me., and annite from Rockport. Their compositions may be represented by the formulas

$R'_6R''_4R'''_2Si_5O_{28}$ (Rockport); $R'_6R''_3R'''_4Si_5O_{22}$ (Baltimore); and $R'_6R''_2R'''_6Si_5O_{24}$ (Litchfield).

[1] Edited by DR. W. S. BAYLEY, Madison, Wisconsin.
[2] Zeitschrift für Krystallographie, xiii., 1887, p. 1.
[3] Neues Jahrb. f. Min., etc., Beil. Band., v., 1887, p. 318.
[4] Ib., ii. p. 64.
[5] Amer. Jour. Sci., xxxiv., Oct. 1887, p. 131.

The relations existing between them may be best shown by supposing two of the univalent groups (AlO) to replace one (R'''_2O_2). Assuming this, the formulas may be written:

$$R'_{14}R'''_2(SiO_4)_5 = \text{Rockport mica.}$$
$$R'_{12}(AlO)_2R'''_2(SiO_4)_5 = \text{Baltimore mica.}$$
$$R'_{10}(AlO)_4R'''_2(SiO_4)_5 = \text{Litchfield mica.}$$

In the same paper there are also given analyses of iron-micas from Auburn, Me., and Pike's Peak, Colorado, and one of a muscovite from Alexander County, N. C., containing 1.10 per cent. of TiO_2.——*Howlite.*—This mineral was first identified by Professor H. How,[1] of Windsor, Nova Scotia, who named it silico-borocalcite. Messrs. Penfield and Sperry,[2] having recently come into the possession of a comparatively pure specimen of the mineral, have re-examined it. They find it to be composed as follows:

SiO_2	B_2O_3	CaO	Na_2O	K_2O	H_2O
15.33	44.52	27.94	0.53	0.13	11.55

They regard it as a distinct species with the formula $H_5Ca_2B_5SiO_{14}$.——*Cassiterite.*—The tin-stone of Mexico is divided by Professor Genth[3] into two varieties, a red and a yellow variety. Both are supposed to have been formed by precipitation from solution. The red variety is found in very small crystals, with a hexagonal habit. Analysis shows it to consist of dioxide of tin, containing a little ferric oxide and occasionally small quantities of arsenic pentoxide. The yellow variety occurs principally in imitative forms. It contains very little ferric oxide, but considerable arsenic pentoxide, and always an admixture of zinc oxide. Crystals of cassiterite implanted on hematite (after the manner of rutile on hematite from St. Gothard), and pseudomorphs of the former after the latter mineral, as well as after magnetite, are described by Professor Genth as not very uncommon in the sands and ores from the state of Durango.——*Mimetite* has been found in small crystals at the Mina del Diablo, Durango, Mexico. More frequently, however, it occurs in pseudomorphic forms after an unknown mineral, supposed by Dr. Genth[4] to be anglesite, by Professor von Rath to be galena, and by Dr. Brezina to be mendipite.——*Vanadinite.*—This mineral occurs on quartz in the Mammoth Gold Mine, near Oracle, Pinal County, Arizona. It is sometimes coated with calcite, which is in turn coated with a second generation of vanadinite. Other localities for vanadinite are Yavapai County, Arizona; McGregor Mine, Grant County, New Mexico; and Bald Mountain Mine, Beaverhead County,

[1] Philos. Mag., iv. xxxv., p. 32. [2] Amer. Jour. Sci., Sept. 1887, p. 220.
[3] Contributions from the Chemical Laboratory of the University of Pennsylvania. xxix., 1887, p. 4.
[4] Ib., p. 10.

Montana.——*Descloizite* (*ramirite*), from San Luis Potosi, Mexico, yielded Professor Genth[1] on analysis the figures,—

PbO	CuO	ZnO	As_2O_5	V_2O_5	P_2O_5	Loss on ignition
54.52	6.58	12.70	3.63	19.99	0.13	2.62

a result not very different from that obtained by Penfield[2] in 1883.——*Tapalpite*, from the Sierra de Tapalpa, Jalisco, Mexico, is regarded by Rammelsberg as being represented by the formula $Ag_2S.Bi_2Te_2$. Professor Genth[3] has analyzed some comparatively pure material, with this result:

Ag	Pb	Bi	Cu	Te	S
38.59	7.24	25.05	0.21	17.43	8.24

which, after deducting the impurities, would give, as the composition of tapalpite,

Ag	Bi	Te	S
46.09	24.99	21.67	7.25

corresponding to a normal sulpho-telluro salt of silver and bismuth.——In the paper in which the above-mentioned minerals are discussed, Professor Genth describes *pyrite* pseudomorphs after *pyrrhotite*, from Colusa County, Cal.; *hessite*, from Tombstone, Arizona; *allanite*, from Statesville, N. C.; *willemite*, from Socorro County, New Mexico; and *hisingerite* pseudomorphs after *calcite*, from Ducktown, Tenn.——*Bismutho-sphærite.*—This mineral has for some time been regarded as a basic carbonate of bismuth, but its composition has not until very recently been determined by means of analysis. A short time ago Mr. H. L. Wells[4] obtained large specimens of the mineral from Willemantic and Portland, Conn. The Willemantic occurrence is described as a dark-gray mineral, holding in its centre a nucleus of bismuthinite. Its specific gravity is 7.42. Under the microscope it was seen to consist of a dark ground-mass, in which patches of a pale yellowish-green color are scattered. The dark portion is almost opaque from the numerous black dust-like inclusions it contains. These are supposed to represent traces of the original mineral from which the bismutho-spharite was derived. An analysis yielded,—

Bi_2O_3	SO_3	Silicates	CO_2	H_2O
91.64	0.34	0.08	8.03	0.47

corresponding to the formula $Bi_2O_3.CO_2 = (BiO)_2CO_3$.——*Crocidolite.*—Messrs. Chester and Cairns[5] have recently published an analysis of the bluish-gray fibrous crocidolite from Beacon Pole Hill, near Cumberland, Rhode Island, with the result (as the mean of two analyses):

SiO_2	Fe_2O_3	FeO	MgO	Na_2O	H_2O
51 58	16.90	21.22	0.15	6.34	3.79

[1] Ib., p. 15.
[2] Amer. Jour. Sci., xxvi. p. 361.
[3] L. c., p. 18.
[4] Amer. Jour. Sci., October, 1887, p. 271.
[5] Ib, xxxiv., 1887, p. 108.

This composition is represented by the authors by the formula $Fe_3Na_2H_4Fe_2(Si_9O_3)_9 = 3FeO.Na_2O.2H_2O.Fe_2O_3.9SiO_2$, in which the water is regarded as basic. The authors cannot accept the prevalent view that crocidolite is merely a fibrous arfvedsonite. ——*Datholite*.—Mr. Whitfield[1] has analyzed the datholite from Bergen Hill, N. J., determining the boric acid by the Gooch[2] method. His figures are:

SiO_2	FeO	CaO	B_2O_5	H_2O
35.74	0.31	35.14	22.60	6.14

corresponding to the formula $B_2O_3.H_2O.2CaO.2SiO_2 = H.CaSiO_3.BO_2$, the generally accepted formula for this mineral.——*Ulexite*.—Ulexite, from Rhodes Marsh, Esmeralda County, Nevada, yielded the same analyst[3] the following figures:

SiO_2	Cl	B_2O_3	SO_3	CaO	Na_2O	K_2O	H_2O
0.04	2.38	43.20	0.28	14.52	10.20	0.44	29.46

These figures are represented by the formula $NaCaB_5O_9 + 6H_2O$, after making certain allowances for impurities.——*Siderite* (*sphærosiderite*).—This mineral[4] occurs at Baltimore, Md., associated with zeolites in the gneiss of the Jones Falls quarries. The crystals are small and lenticular in shape. They possess only the forms R and oR, except in one instance, where the negative scalenohedron $-\frac{1}{4}R^4$ is supposed to occur. In these crystals the faces are generally rounded, forming a lens-shaped body. Frequently two of these lenses are grouped together so as to form apparent twins. And further, many lenses grouped together produce a perfect sphere. Analyses of selected material by Mr. A. G. Palmer gave,—

FeO	MgO	MnO	ZnO	CO_2
59.63	1.05	0.91	1.72	37.93

It is thought that the presence of manganese and zinc may have had some influence in the production of these rounded forms, not uncommon in the pure manganese carbonate-rhodochrosite. ——*Samarskite*.—Samarskite[5] is found in the coarse-grained granitic veins cutting the schists in which the zeolites (referred to above) occur. It is described by Professor König as a very splintery, black mineral with a hardness of about 6–7. Its specific gravity is 6.146. An analysis yielded,—

Metallic acids	UO_2	Y, Er, etc.	(CeTh)O	FeO
56.40	13.48	11.90	3.85	8.98
Fe_2O_3		Al_2O_3	Ignition	
1.66		2.00	0.30	

[1] Ib., October, 1887, p. 281.
[2] Amer. Chem. Jour., ix., 1887, p. 23, and ii., 1880, p. 247.
[3] L. c.
[4] Notes on the Minerals occurring in the Neighborhood of Baltimore, by G. H. Williams, Ph.D., Baltimore, 1887, p. 12.
[5] Ib., p. 16.

The specific gravity of the metallic acids (5.769) is too high for niobic acid, while no tantalic acid was detectable by Rose's method,—facts which Professor König does not understand.——*Beaumontite.*—Several crystals of this mineral have recently been measured by Messrs. Burton and Gill,[1] who find no reason to suppose that it is not crystallographically identical with heulandite, as Des Cloizeaux found it to be in its optical properties.——*Rutile.*—The rutile crystals occurring in the spodumene-bearing pockets of the gneiss in Sharp's township, Alexander County, N. C., are described by Messrs. Hidden and Washington[2] as small, with the rare basal pinacoid prominent and well polished. Measurements of these crystals resulted in the detection of the new forms $\frac{2}{7}$P, $\frac{1}{2}$P, $\frac{2}{3}$P, 4P, and P$\frac{9}{8}$. A recalculation of the axial relations gave 1 : 0.64425.——*Apatite.*—A small crystal of apatite implanted on muscovite, from the same locality as that mentioned for rutile, is described by the same writers as almost unique in habit, the prisms $\frac{1}{2}$P, P, and 2P2 predominating. From data obtained in the measurement of this crystal, a recalculation of the axial relations for apatite gives this as 1 : 0.7343. A cruciform twin of apatite is described and figured, in which the twinning plane is 2P2. This is interesting as the first description of a twin of this species.——*Beryl.*—Two new planes have been discovered by the same authors on the emerald beryls of the Alexander County locality. These planes are $\frac{1}{12}$P and $\frac{15}{7}$P$\frac{15}{8}$. On all the beryl from this locality it was observed that the prism face ∞P is perfectly smooth, while ∞P2 is covered with little triangular pits.——*Quartz.*—Some time ago Vom Rath[3] noted the occurrence of the plane ∞P$\frac{4}{3}$ on the alternate prismatic edges of certain quartz-crystals from Alexander County, N. C. Messrs. Hidden and Washington[4] find this same form holohedrally developed in each consecutive prismatic edge.——*Topaz.*—A clear crystal of topaz[4] from Zacatecas, Mexico, contains the new plane 7P∞.——*Pyroxene.*—Certain crystals of pyroxene from Orange County, N. Y., possess[5] a tubular habit due to the development of the basal plane, and are remarkable besides in that they are hemimorphic in the direction of the vertical axis. The upper portions of the crystals show the forms oP, —P, P, 2P, ∞P, ∞P∞, and ∞P$\overline{\infty}$. Moreover, the lower planes are so developed that these portions of the crystals must be regarded as twinned, while the upper portions are simple individuals.——*Scorodite.*—In a late number of the *American Journal of Science*, Mr. Hague[6] discusses the deposition of scorodite from the arsenical waters of the Yellowstone National Park. The mineral occurs as a green coating covering the siliceous sinter de-

[1] Ib., p. 10.
[2] Amer. Jour. Sci., xxxiii., 1887, p. 501.
[3] Zeits. f. Krystal., xii., p. 456.
[4] L. c.
[5] G. H. Williams, Amer. Jour. Sci., Oct. 1887, p. 275.
[6] September, 1887, p. 171.

posited by the Joseph's Coat Springs and other geysers, and is also often found in little nodules in the cavities of this sinter. An analysis of the purified scorodite yielded Mr. Whitfield,—

Fe_2O_3	As_2O_5	H_2O
34.94	48.79	16.27

Analyses of the waters of these geysers show a small percentage of arsenious acid.——Reusch[1] has examined the crystallized *kaolin* from Denver, Colorado, to which Cross and Hillebrand first called attention.[2] He declares it to be triclinic and not orthorhombic as Hillebrand supposed.——A. Kenngott[3] describes two peculiar crystals of *gypsum* from Poland, Ohio, and calls attention to a new formula for *tantalite* from Dakota, based upon the analysis of Schaeffer,[4] published a few years ago.

BOTANY.[5]

The Genus Geaster.[6]—Dr. G. B. De Toni, of the Botanical Institute of the University of Padua, has lately made a careful revision of the genus Geaster. Accepting, with Fries, the definition of the genus as proposed by Micheli in 1729, after much reduction, he increases the number from fourteen, as enumerated by the illustrious Swedish savant in 1829, to forty-eight well-authenticated species. Making a careful study of the leading features of the species, he has been enabled to arrange them into seven quite distinct and fairly recognizable sections, as follows:

1. COLUMNATI.—*Inner peridium supported on several pedicels.*

This section includes the singular *G. coliformis* Dicks. with many mouths to the inner peridium, and *G. columnatus* Lev., from Chili, having but a single orifice.

2. FORNICATI.—*Outer peridium separating into two distinct strata, one obversely fornicate.*

This contains three species,—*G. fornicatus* Huds., and the little-known *G. radicans* B. & C., and *G. welwitschii* Mont. We may here remark that this fibrous lowest stratum clinging to the earth exists in *G. limbatus* Fr., and perhaps in several other Geasters.

3. CUPULATI.—*Outer peridium augmented by a membranaceous, often irregular cupule about the base of the inner peridium.*

This section contains only *G. triplex* Jungh. and the uncertain *G. duplicatus* Chev. We have observed this basal membrane in other species of Geaster; it occurs as a mere incidental breaking away of the lower portion of the inner fleshy stratum of the outer peridium. Specimens of *G. duplicatus* are to be found

[1] Neues Jahrb. f. Min., etc., 1887, ii., p. 70. [2] Bull. U. S. G. S., No. 20.
[3] Ib., 1887, ii., p. 84. [4] Amer. Jour. Sci., 1884, xxviii., p. 430.
[5] Edited by Prof. CHARLES E. BESSEY, Lincoln, Nebraska.
[6] "Revisio monographica generis Geasteris, Mich." Auctore Dr. G. B. De Toni. Revue Mycologique, No. 34, Avril, 1887.

without the basal cupule, though it is generally present in all fully-grown examples. This leads us to suggest that it might be well to distribute the species of sections 2 and 3 among those that follow.

4. STRIATI.—*Peristome sulcate-plicate or pectinate-striate.*

A well-marked section! It comprises ten species. The salient species are *G. bryantii* Berk., *G. umbilicatus* Fr., and *G. striatus* D. C.; the others cluster about them as more or less closely-related species. The five species, *G. striatus*, *elegans*, *striatulus*, *ambiguus*, *drummondii*, form an elegant group of remarkably near relatives.

5. FIMBRIATI.—*Peristome fimbriate-floccose or ciliolate, situated in a circular, distinctly radiate-fibrillose areola.*

This section comprises the largest number of species (twenty altogether). The well-known species are *G. minimus*, *limbatus*, *fimbriatus*, *mammosus*, *saccatus*. It contains a curious xylophilous group of four species, represented by the *G. mirabilis* Mont. The numerous species clustering about *G. fimbriatus* Fr. and *G. saccatus* Fr. are difficult of definition; these two are near enough related, the presence and absence of the circular areola being the only obvious mark.

6. PAPILLATI.—*Peristome papilliform, glabrous.*

This section contains two small species,—*G. floriformis* Vitt. and *G. pusillus* Fr.,—which may be identical.

7. EXAREOLATI.—*Peristome either dentate, always destitute of the circular areola, or irregularly or stellately dehiscing.*

This section comprises nine species, including the well-known *G. rufescens* Pers. and *G. hygrometricus* Pers.

Besides the forty-eight species of these seven sections there are five additional species less known or imperfectly described, among them the singular *G. linkii* Spreng., which does not seem to have been found by any one except Link and Schweinitz. If there are specimens of it in Schweinitz's herbarium, they should be carefully described.

There is an interesting table of the geographical distribution of the species. The seventeen species in the United States might have been increased by the addition of *G. coliformis*, from the *Journal of Mycology*, vol. i. p. 7.

Two good plates figure several characteristic species and others not so well known.

From the Western plains we have lately received two species wholly unlike any examples in our possession, and which seem to us quite different from any of the species described in Dr. De Toni's monograph. We figure and characterize them as follows:

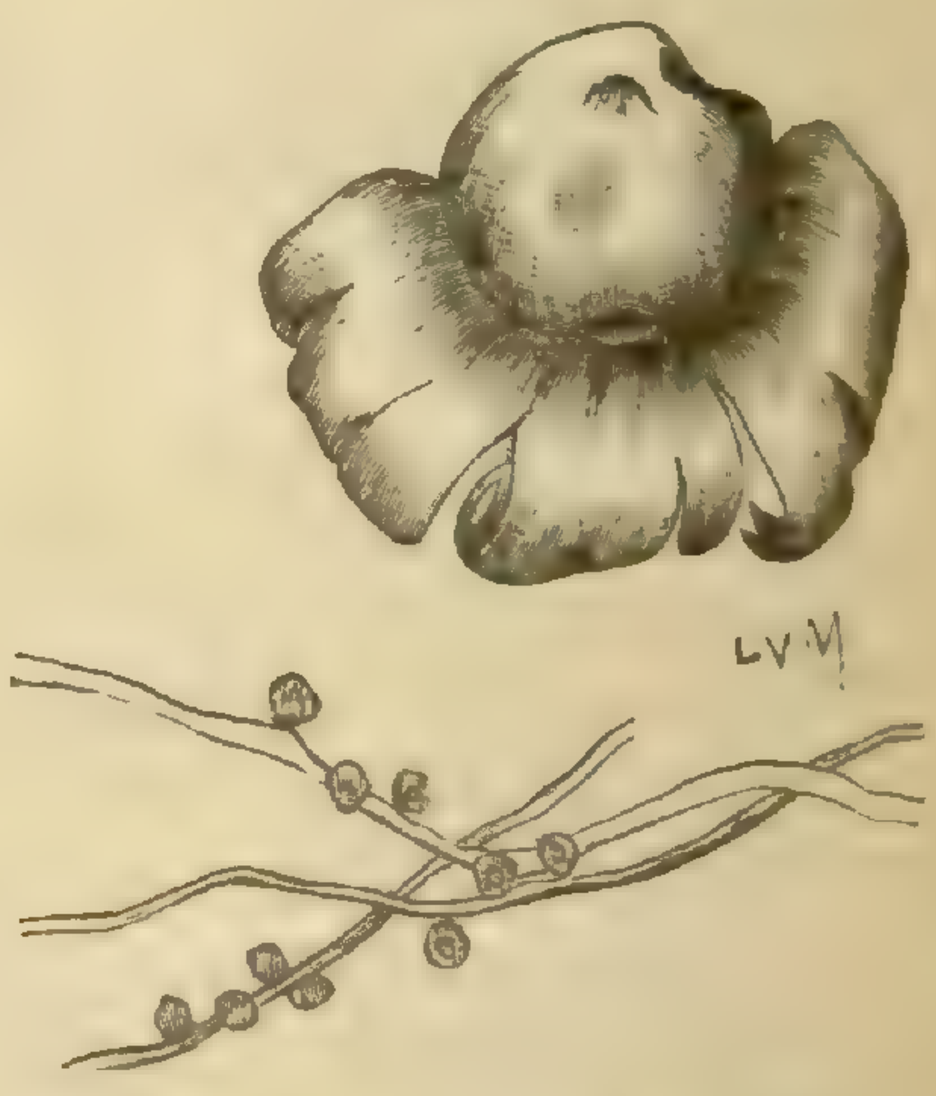
1. *Geaster campestris* Morg. (Fig. 1).—Outer peridium thick, multifid; the segments (eight to ten) reflexed, whitish below, rufescent within. Inner peridium globose, subpedicellate, verru-

cose, gray, or brownish, the mouth conic, sulcate-plicate, in a circular, marginate disk. Spores globose, verruculose, brown, .0055–.007 mm. in diameter.

Growing in clusters, at first half immersed in the soil, on the open prairie about Lincoln, Neb. Sent by Prof. Charles E. Bessey.

FIG. 1.

FIG. 2.



Inner peridium three-eighths to three-fourths of an inch in diameter, the expanded segments one to two inches. The outer peridium is concave or vaulted underneath, with the segments often inflexed at the tip, as in *G. bryantii* and *G. limbatus;* it also has the same fibrillose stratum beneath binding it to the soil; when this is cleared away it leaves a smooth, whitish outer surface. In most of the dried specimens the inner peridium is distinctly pedicellate. The peculiar feature of this species, however, is the minute, scaly or granulose warts which invest the surface of the inner peridium; there is no other species with a similar surface, unless it be the *G. granulosus* Fuckel, which is described as "covered with a white granulose powder." Moreover, it has a filamentous peristome, and belongs among the *Fimbriati*, while our species belongs to the *Striati* of Dr. De Toni's arrangement.

2. *Geaster delicatus* Morg. (Fig. 2).—Outer peridium thin, multifid; the segments (six to ten) unequal, revolute, whitish below, alutaceous within. Inner peridium depressed-globose, sessile, puberulent, pallid; the mouth lacerate. Spores globose, verruculose, fuscous, .005–.006 mm. in diameter.

Growing on the prairie around Lincoln, Neb. Sent by Prof. Charles E. Bessey.

Inner peridium one-fourth to one-half of an inch in diameter, the expanded segments an inch or more. The segments, when fresh or wet, are strongly revolute, and become inflexed when dry, after the manner of *G. hygrometricus;* they are nearly papyraceous, the inner, fleshy stratum being remarkably thin; the color outside is whitish or glaucous, and the external surface is

very smooth. There is no determinate circular areola to the inner peridium and the mouth is stellately lacerate or sometimes a mere slit or puncture. The nearest relative would appear to be *G. bovista* Klotsch, from which it differs in several particulars; it belongs to the same section, the *Exareolati*, of Dr. De Toni's monograph.—*A. P. Morgan, Preston, Ohio.*

ENTOMOLOGY.[1]

Observations of Portchinski on Flies which, in their Larva Stage, cause Diseases among Men and Animals.—Baron Osten Sacken gives[2] an account of some publications of Mr. Portchinski, from which we extract the following, as of general interest:

For many years past Mr. Joseph Portchinski (at present secretary of the Entomological Society in St. Petersburg) has been devoting a great deal of time to the study of the life-habits of carnivorous and coprophagous larvæ of Muscidæ, and several valuable publications on that subject are due to his pen already. But as most of these publications are written in Russian, they have remained less known than they deserve. Several of them, however, have appeared in German in the *Horæ Soc. Ent. Ross.*, and two of these are on the subject indicated in the heading to this extract.

The principal result which science owes to these papers is the elucidation of the history of *Sarcophila wohlfahrti* as a dangerous but hitherto unrecognized enemy of men and animals, the European substitute of the celebrated *Lucilia macellaria* (syn. *L. hominivorax*) of America. In 1768, Dr. Johann August Wohlfahrt, physician in Halle, published a paper ("Observatio de Vermibus per Nares excretis") describing a case where peculiar worms in the nose of an old man produced intolerable headache, and almost drove him to madness. Wohlfahrt succeeded in breeding the fly of these larvæ, and gave a description, accompanied with figures sufficient for the recognition of the species. Numerous similar cases have been observed since, and either altogether misunderstood or else ascribed to different other species of common carnivorous flies,—species of *Sarcophaga*, *Lucilia*, *Calliphora*. To Mr. Portchinski belongs the merit of having pointed out that the great majority of the cases of the *Malum verminosum* observed on men and animals are produced by that particular species, described more than a century ago by Wohlfahrt, and so far overlooked since, owing probably to its close resemblance to other species, that it was described for the first time by Schiner in 1862 only, who had no idea of its

[1] This department is edited by Prof. J. H. Comstock, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

[2] Berliner Entomolog. Zeitschrift, Bd. xxxi. p. 17.

dangerous propensities, nor of its identity with the species described but not named by Wohlfahrt. Mr. Portchinski shows that *S. wohlfahrti* occurs all over Europe, that it attacks animals, domestic and wild, and that occasionally it causes horrible sufferings and even death among men. In the work of Dr. Megnin, "Les Parasites et les Maladies parasitaires," Paris, 1880, the author acknowledges Mr. Portchinski's conclusions, and says that every time he succeeded in breeding the fly from such larvæ it was the *Sarcophila wohlfahrti* which escaped from the pupa.

Lack of Parallelism between the Characters of Larvæ and Adults.—"The new article of Mr. Portchinski, 'Comparative Biology of the Necrophagous and Coprophagous Larvæ,'[1] brings us a series of important observations, and illustrates the wonderful power of adaptation of these larvæ to their environment,—an adaptation which, in a certain measure, destroys the parallelism which we naturally expect to exist between the systematic characters of larva and imago. Such apparent want of parallelism has been observed in the order Diptera before, but an abundance of new facts are found in Mr. Portchinski's paper. Distantly-related species, belonging to different genera, issue from larvæ almost undistinguishable from each other; and, again, closely-related and almost undistinguishable imagos, species of the same genus, differ in their oviposition (size and number of eggs), and their larvæ follow a different law of development as to the degree of maturity the larva reaches within the body of the mother, and the number of stages of development it passes through). In one case even (*Musca carvina*) larvæ of the same species were found to have a different mode of development in northern and southern regions." (Osten-Lacken, *l. c.*)

The Colorado Potato-Beetle in Europe.—The Colorado potato-beetle has appeared in large numbers upon the potato-fields of Malitzsch, a village near Dommitzsch, in Saxony. It is believed, from the abundance of the beetles, that the species must have been introduced into that locality several years ago. The Prussian government is taking vigorous measures to exterminate the pest.

Recent Publications.—Among the recent publications upon our table are two systematic works which are worthy of more than a passing notice. One of these is a "Synopsis of the North American Syrphidæ," by Dr. S. W. Williston. This constitutes Bulletin No. 31 of the United States National Museum. It is an octavo of three hundred and sixty-four pages. It contains full descriptions of all our species,—about three hundred in number. In the introduction there are given synoptic tables of

[1] Horæ Soc. Ent. Ross., vol. xix. pp. 210–244.

the tribes and genera; and in the body of the work each generic description is followed by a table of the species when the genus contains more than one.

The second of these systematic works is "A Monograph of the Aphodiini inhabiting the United States," by Dr. George H. Horn.[1] In this monograph eighty-two species are enumerated. Each species is fully described, and synoptic tables for separating them are given. The work is done in the careful manner characteristic of Dr. Horn's writings. It is based on practically a complete series of specimens. Only two of the species are unknown to Dr. Horn, and all but four are in his cabinet. The descriptions are so definite that specimens can be determined from them with certainty.

From the Department of Agriculture at Washington we have received the annual report for 1886, containing the report of Dr. Riley as entomologist; and from the same source we have received Bulletins Nos. 13, 14, and 15 of the Division of Entomology. The more important of the topics discussed in these reports are the following: "The Cottony Cushion-Scale," which is doing great injury in California; "The Southern Buffalo-Gnat," "The Fall Web-Worm," and "Insects Injurious to Wheat."

A considerable amount of literature on the *Coccidæ* has appeared recently. In addition to Dr. Riley's reports on the Cottony Cushion-Scale, Miss Ormerod publishes a pamphlet on the same insect, entitled "Notes on the 'Australian Bug' in South Africa." In the *Transactions of the New Zealand Institute* Mr. Maskell publishes an article "On the 'Honeydew' of Coccidæ and the Fungus accompanying these Insects," and from the press of the Government Printer at Wellington there has just been issued a volume by Mr. Maskell on the "Scale Insects of New Zealand." This is illustrated by twenty-three plates, nearly all of which are colored.

In Bulletin No. 2 of the State Entomologist of Illinois Professor Forbes treats of "The Present Condition and Prospects of the Chinch-Bug in Illinois."

ZOOLOGY.

Sense Organs of Turbellarians.—Dr. L. Böhring has recently published (*Zool. Anzeiger*, 260) a preliminary account of the eyes, etc., of several species of planarians. In *Planaria gonocephala* each eye consists of a nervous apparatus and a pigment-layer, and the latter, unlike the eyes of Lang's Polyclada, consists of many nucleated cells united. The cavity of this pigment-layer is filled with end organs, each of which has a complicated structure, though this whole apparatus has previously been described

[1] Trans. Am. Ent. Soc., vol. xiv. p. 1–110.

as a hyaline, structureless formation. Each end organ connects with a nerve-fibre, which in turn leads back to a unipolar cell of the optic ganglion. No lens is to be recognized in the sections. In *Vorticerus auriculatus* the two eyes (which lie directly on the brain) have the optic cavity divided into two chambers by a middle pigmented wall. Each cavity is filled by fine rods, leaving a central canal free. Around the margin of the capsule are numerous cells, which resemble ganglion-cells, and which send fibres to the rods, and hence are regarded as retina-cells.

A Parasitic Rotifer.—Nearly twenty years ago E. Ray Lankester briefly described and roughly figured a rotifer, which he found parasitic in the body-cavity of Synapta from the Island of Guernsey. Recently Dr. Zelinka has found the same form in the Adriatic, and describes it as *Discopus synaptæ* nov. gen. et sp. According to the latter author this is not an endo-parasite, but lives in folds of the skin of the Synapta, and from these large numbers may be taken by a pipette. The animal belongs to the Philodinidæ. Zelinka has been able to stain and section these animals, and describes their internal structure in some detail. His conclusions are (1) that the bilobed wheel of the Philodinidæ can be homologized with the ciliated band of the trochosphere, (2) that the anterior end of the outstretched body is homologous with the "scheitelplatte," and (3) that the brain of the rotifer arises partly from separation from the scheitelplatte, and partly from immigration of primitively peripheral ganglion-cells.

The Genus Sesarma.—In 1818 Thomas Say described the genus *Sesarma* for a Floridan species of crab belonging to the Grapsoid group. Since that time numerous other species of the same genus have been described from all parts of the world, the latest list embracing seventy-one nominal species, the limits and synonymy of which are in almost inextricable confusion. Lately (*Zoologische Jahrbuch*, ii. 1887) Dr. J. G. de Man has attacked the Indo-Pacific species of the genus, and introduced some order into their classification. He divides the genus into four groups, based upon the character of the upper margin of the hand and the teeth of the margin of the carapax. He also regards the genus *Sarmatium* of Dana as of sub-generic value. In the same paper he further includes the results of a study of the Crustacean types of Hess and Nauck, by which a large number of nominal genera and species are thrown into synonymy.

Preliminary Notes on the Osteology of Alosa sapidissima.—In the shad the muscle of the lateral line is very largely developed, and extends down quite deeply between the dorsal and ventral masses of the lateral muscles. In the connective tissue

between the segments of the muscle of the lateral line a series of vertical cartilaginous plates are developed, extending backward and outward. They are irregularly triangular in outline, and the apex of the triangle, which is directed forward and inward, overlaps the distal extremity of the epicentrale. These cartilages seem to be evidence that a process of differentiation is going on in the shad similar to that which resulted in the differentiation of the sense organs of the head, and give support to the theory that these are derived from integumentary sense organs allied to those of the lateral line.

A consideration of their relation to the other skeletal elements of the abdominal segments suggests that the foremost visceral arches are not homologous with the branchial arches, but may belong to a series including the extra-branchials of Parker, the scapula portion of the pectoral arch, and the epipleurals.

They also suggest an origin for the free portion of the paired limbs from a ventro-lateral series of sensory organs, similar to those seen in amphibian larvæ which lie in a line connecting the fore and hind limbs.

Such a development might afford some explanation of the cephalic fin present in some elasmobranch fish either as a survival, or a reversion.—*Fanny R. M. Hitchcock.*

To the Editors of the Naturalist:

Sirs,—Owing to the failure of the corrected revise to reach the publishers, my article, "Remarks on Classification," in the October number, requires some comment:

1. On page 915, last paragraph, the words *neither tubular nor even grooved* should be *never tubular.*

2. Near the bottom of the Table, the equivalent of Stereoneura should be "*invertebrates*"—*tunicates.*

3. At about the middle of the Table, under Monocœlia and Polycœlia, the words *axon unsegmented* and *axon vertebrated* should be omitted.

4. On page 915, in the last line of the second paragraph, *will* should be *may.*

5. In several places the words *centre* and *synonyme* should be *center* and *synonym.* While the forms imposed by the publishers are sanctioned by Worcester, I prefer to follow Webster, as with *pseudonym, theater, meter,* etc. So long, indeed, as these two words and *center* are pronounced by all English speakers in two syllables, there seems to be no more reason for retaining the French orthography than in the case of *chambre,* which is always Anglicized as *chamber.*

Burt G. Wilder.

Ithaca, N. Y., October 29, 1887.

Zoological News.—Cœlenterates.—Mr. Richard Rathbun catalogues, with notes, the species of the genus Madrepora in

the United States National Museum. This collection is rich in type specimens of corals, containing, as it does, those which formed the bases of both Dana's and Verrill's descriptions of two large American exploring expeditions. In all fifty-nine species are enumerated. Later in the same volume he does the same work for the species of Porites and Synaræa. Twenty-three species of Porites (including *P. branneri* nov.) and three of Synaræa are included.

WORMS.—Fletcher and Hamilton describe, in a recent paper, fourteen new species of Land Planarians from Australia. Some of these have two eyes, and are referred to Leidy's genus Rhynchodemus. Some of their specimens agree well with species belonging to Moseley's genus Cænoplana, except that they have well-developed eyes,—a fact which leads them to regard that genus as synonymous with Geoplana.

VERTEBRATES.—Dr. Giglioli, of the Royal Museum of Florence, describes (*Zool. Anzeiger*, No. 261) a new species of Cercopithecus from Central Africa. It belongs to Schlegel's sixth group of the genus, and is allied to *C. leucampyx*, etc. It is named *C. boutourlinii.*

In the same journal (*Zool. Anzeiger*, No. 261) Dr. C. Zelinka notices a strange instance of batrachian teratology. In the urinary bladder of a specimen of *Salamandra maculata* he found a normal larva of the same species, pigmented, and two and one-half centimetres in length.

Mr. Charles H. Townsend contributes a series of valuable field-notes on the mammals, birds, and reptiles of Northern California to the *Proceedings U. S. National Mus.* for 1887. Among the more important points brought out are notes on the teratology of the antlers of *Cariacus columbianus*, and on the habits of the porcupine. He says that skunks killed as directed by Baird—caught in a box-trap and drowned—do not discharge their fluid as when killed in other ways.

F. W. True describes a new bat (*Vespertilio longicrus*) from Puget Sound in the *Proc. Nat. Mus.* for 1887, and in the same place gives cranial characters which he regards as distinctive of the Canada lynx.

Jordan and Evermann give a review of the food-fishes of Indiana in the last Agricultural Report of that State. Out of the hundred and fifty species but about fifty ever appear in the markets as food-fishes. The lake-sturgeon is said to spawn in the rivers in June, the red-horse in May,—points of interest to those who are studying Teleost embryology.

Francis Day describes (*Proc. Zool. Soc. London*, 1887) a supposed hybrid between the pilchard and the herring, the scales and coloring of the two sides of the body presenting the characters of each of the parent species respectively. The same

author has a paper on the Loch Leven trout in the *Journal of the Linnean Society* for this year. He does not, however, come to any decision as to the specific validity of the form in question.

Prof. E. D. Cope describes (*Proc. U. S. Nat. Mus.*, 1887) a new species of Tropidonotus, from Washington, D. C., under the name *T. bisectus*. In its affinities it is nearest to *T. woodhousei*, and the fact that it occurred in a region so carefully studied lends plausibility to the view that it is an introduced species.

Dr. van Lidth de Jeude contributes some notes on a collection of fishes and reptiles from the West Indies to vol. x. of the Leyden Museum *Notes*. The new species described are *Gymnodactylus antillensis*, *Phyllodactylus martini* (=*P. julieni* Cope), *Cnemidophorus arubensis*, *Crotalus horridus* var. *unicolor*, *Pœcelia candepolli*, and same var. *arubensis*. A larger acquaintance with American literature would have reduced the number of nominally new species.

EMBRYOLOGY.[1]

Development of the Cœcilians (*Ichthyophis glutinosus*).[2]—The remarkable discoveries of the brothers Sarasin during their sojourn in Ceylon are now in course of publication, and promise to clear up some very important questions in morphology and taxonomy. This is the case with the memoir before us.

After surmounting many discouraging difficulties, the Sarasins have succeeded in presenting a pretty full account of the development of the remarkable, worm-like, limbless salamanders of the genus *Ichthyophis*. The ova are laid in strings, joined together by continuations of the egg-membrane, so as to remind one of a string of beads. The individual ova are quite large, or nearly the size of a marrow-fat pea. There is a considerable albuminous investment to each ovum, and at the points where the ova are joined together there is a well-defined chalaza developed at opposite poles, these chalazæ seeming to join adjacent ova together through the narrow tubular connections formed by their common coverings. The female guards her ova in a burrow, and not the least charming feature of this memoir is the skill with which the famous zoological artist Mützel has succeeded in giving a most spirited rendering of the animal in its burrow coiled about its ova. This effective picture has been composed from photographs taken from life by the authors.

On account of the very large size of the ovum the mode of development differs very considerably from that of other Amphibia, in that a very distinct blastoderm is formed, which slowly invests by epiboly the underlying yelk, as in Elasmobranchs, Reptilia, Teleostei, and Aves. The formation of the embryo

[1] Edited by JOHN A. RYDER, Ph.D., Biological Department, University of Pennsylvania.

[2] Ergebnisse naturwissenschaftlicher Forschungen auf Ceylon. Heft II., 4to. Wiesbaden, 1887. Kreidel.

and the method of infolding of the medullary groove is, however, characteristically amphibian. At the posterior end of the embryonic area the furrows characteristic of the Amphibia appear. As segmentation proceeds, the yelk-granules are taken up into the cells of the blastoderm as they are into the cells of the embryo in other Amphibia, and in Petromyzon, as I am informed by Prof. Scott, of Princeton.

The cranial flexure is profound, and at times the head is well differentiated, the branchial clefts and visceral arches are developed with great distinctness, so that from the side the head presents, at this stage, an appearance which is decidedly like that of an embryo of a bird or a mammal. The last remnants of the yelk are not absorbed below the cardiac region as in Teleosts, but the yelk-sac is carried far back, so as to occupy a position in front of the vent. In this respect there is a resemblance to the mode in which the last remnant of the yelk is absorbed in the Marsipobranchs, on which account the writer has called the latter *opisthotrophous* in reference to this peculiarity. The embryo is also folded off from the yelk somewhat in the same manner as in Marsipobranchs, the head first becoming free and then the trunk. There is a very distinct vascular net-work formed over the yelk at a late stage, much as in *Alytes*, as described by C. Vogt many years ago.

The embryo also becomes coiled up in the ovum, and then, some time before its escape from the egg, three beautiful plumose or pinnate branchial processes grow out from either side in the region of the posterior branchial clefts. These are compared with the plumose branchiæ of the larvæ of *Megalobatrachus japonicus* from Japanese figures. An amended figure of the larva of *Typhlonectes compressicauda*, another Cœcilian, is also given, and the account of Peters, which was based on the same material, corrected. The Sarasins find that the single pair of branchiæ in *Typhlonectes* are not vesicular, as supposed by Peters, but leaf-like.

Another singular feature which the memoir reveals is the presence of vertical tail-folds on the tail of the larvæ of Ichthyophis; these extend forward to the vent, and back over the end of the tail, and forward over the dorsal side a little in advance of a vertical line from the anus.

Still more remarkable is the development of a pair of rudimentary limb-buds, representing the hind limbs, on either side of the vent, or cloaca. These afterwards undergo a retrogressive metamorphosis. The occurrence of a vertical tail-fold in the larva of Ichthyophis reminds one of the development of such structures in adult Urodeles, such as Triton, while the abortive limb-buds prove beyond question that these singularly modified burrowing and worm-like amphibians are undoubtedly descended from types which possessed well-developed ambulatory organs, as proposed by Cope.

The Origin of the Segmental Duct in Elasmobranchs.[1]—J. Beard, in a note in the publication cited, finds that in *Scyllium* and *Torpedo* the segmental duct is of epiblastic origin, as previously determined by Hensen and Flemming in the rabbit, Spee in the guinea-pig, Van Wijhe in the skate, J. von Perenyi in *Rana esculenta* and *Lacerta viridis*. Beard concludes his note with the presentation of a view almost identically the same as that previously urged by Haddon, to whom he, in fact, in a postscript, gives the credit of having been the first to suggest the origin of the segmental ducts and the establishment of their connection with the cloaca, as given in an abstract of Professor Haddon's paper, given in a recent number of this journal.

The Vestiges of a Zonary Decidua in the Mouse.—An account of some researches on this subject was given in the August number of this journal by the editor of this department. Since then, my assistant, Mr. Geo. Fetterolf, has prepared sections of some of the material in my possession, cut in such planes as to display the relations of the parts involved very clearly.

I find that the at first greatly thickened portion of the mucous membrane in the region of the embryos undergoes some very marked changes. At first the mucosa thickens very much around the embryo. This thickening forms a ring of tissue around the blastodermic vesicle. The only portion of this ring which persists is that which lies in the vicinity or on the site where the discoidal placenta is subsequently formed. The portions of the thickened ring of the mucous membrane on the side opposite the placenta and at the sides of the blastodermic vesicle are absorbed, as sections through the uterus and fœtus of a later stage prove. The hoop-like thickening which is continued from opposite sides of the placental region, and which encircles the fœtus and its membranes, is, as assumed in my previous note, nothing more or less than the transitory representative of a zonary or girdle-like decidua, all traces of which are lost before the end of fœtal life.

The mode in which this hypertrophied portion or annular band of the mucosa is absorbed is highly interesting. In the intermediate stages, at either side of the discoidal placenta and just where the maternal tissue of the placenta is continued into what was formerly the much thickened, but now nearly absorbed ring of thickened mucous membrane, there are found groups of huge cytoclasts or phagocytes, which are evidently the agents in the destructive metamorphosis of the abortive portion of the mucosa which has proceeded only a little way towards the formation of a zonary placenta. The presence of abortive villi on the surface of the chorion in the vicinity is a further proof of

[1] Anatomischer Anzeiger, ii., No. 21, p. 646, 1887.

this. The area of the *chorion frondosum* is very small, not over one-fourth of the area of the under side of the placental disk. The portion of the chorion underlying the placental disk, but not united with it, belongs to the *chorion læve*, and its abortive villosities even extend over and are developed on its surface somewhat beyond the edge of the placental disk.

The cytoclasts spoken of above are many times the size of any of the rest of the cells found in the uterus, fœtus, or fœtal membranes, and they also possess very large nuclei. The processes of adjacent cytoclasts spoken of frequently join, and there is thus formed a sort of syncytium. This syncytial structure, if isolated, would form a ring composed of cytoclasts just at the edge of the placenta, and is especially developed at about the time the zonary band of mucous membrane around the fœtus is nearly absorbed.

These data furnish further proof that the primitive or ancestral type of placentation was a more diffuse one than in existing Rodents of the myomorph type, and throws some additional light on the manner in which a discoidal type of placentation has been derived from one which was zonary.—*J. A. Ryder.*

PSYCHOLOGY.

On Duration of Memory in Wasps.—In studying the psychology of insects, it is noteworthy that we have very little satisfactory evidence with regard to duration of memory. Belt's observation on leaf-cutting ants, which tends to show recollection of a locality for one year, is by no means conclusive, as the facts are as well, if not better explained by supposing that the ants accidentally stumbled upon the old vacant nest. Also with bees, the observations of both Stickney and Huber are inconclusive. Stickney's evidence on the subject, as given by Romanes,[1] is as follows:

"Stickney relates a case in which some bees took possession of a hollow place beneath a roof, and having been then removed into a hive, continued for several years to return and occupy the same hole with their successive swarms."

It would be hardly safe to conclude that bees have extended powers of memory from so indefinite an account as this.

Again we quote from Romanes:[2]

"Similarly Huber relates an observation of his own, showing the duration of memory in bees. One autumn he put some honey in a window, which the bees visited in large numbers. During the winter the honey was taken away and the shutters shut. When they were again opened in the spring, the bees returned, although there was no honey in the window."

The obvious criticism is that we have no evidence that the

[1] Animal Intelligence, p. 154.

[2] L. c., p. 155.

bees that came in the spring were identical with those that came in the preceding autumn, it being possible, and indeed probable, that they visited the window in the second case, as they did in the first, by accident.

The facts which we have already published with regard to the recollection of the properties of glass by hornets[1] suggest, but scarcely establish, a memory of ten or twelve days' duration. Sir John Lubbock's observations demonstrate that bees remember for at least one day a locality in which they have found honey, but we recall no experiment, not open to serious objections, that tends to prove for ants, bees, or wasps a duration of memory greater than twenty-four hours.

The small number of published facts on this subject led us to make an attempt, during the past summer, to obtain some definite data as to the duration of memory in wasps. With this end in view, on August 18, we took from a nest of *Vespa maculata* forty-three wasps, imprisoning them in a large wire cage, and feeding them with apples. We kept them until August 20. Unfortunately, all died but seven. We marked these by a cut on the right upper wing, and set them free at a distance of thirty yards from the nest. They flew in various directions.

On August 22 we took forty wasps from the nest. These we carefully protected from cold at night. We fed them on apples and apple-jelly. Owing, probably, to the better care they kept strong and energetic.

On August 25 we liberated seventeen, marked by a cut on the left upper wing, thirty-five yards from the nest. The majority of these flew towards the nest. A few settled on the ground.

On August 26 we liberated thirteen, with both upper wings cut, thirty-five yards from the nest. They seemed to be in fairly good condition, and flew in various directions, several of them settling near us on the ground.

On August 27 we took seventy wasps from the nest, and gave them every care and attention, intending to keep them out for five or six days. They died in such numbers, however, that on August 29 we took the survivors, eight in number, and, after marking them with a V cut on one wing, set them free at a distance of two hundred and sixteen yards from the nest. Most of these settled near by. A few flew towards the nest.

Having stopped the entrance on the evening of August 29, on the morning of the 30th we poured a solution of cyanide of potassium into the nest, killing all the inhabitants. We then examined the dead wasps, one by one, to determinine how many of those that we had marked and liberated had returned to the nest. The result was as follows:

Of seven which had been retained fifty hours and were liber-

[1] Proceedings of the Natural History Society of Wisconsin, pp. 121–22.

ated thirty yards from the nest, we found five. Of seventeen which had been retained seventy-two hours and were liberated thirty-five yards from the nest, we found eleven. Of thirteen which had been retained ninety-six hours and were liberated thirty-five yards from the nest, we found six. Of eight which had been retained forty-nine hours and were liberated two hundred and sixteen yards from the nest, we found none. It thus appears that wasps remember the locality of their nests for ninety-six hours.

We had hoped to collect a much larger store of facts upon this subject, but were prevented from doing so by the difficulty of keeping the wasps alive after we had taken them from the nest, and by a lack of material to work upon. We were able to find only one wasp-nest during the entire summer, although in the summer of the year before we had found thirty-three nests in the same neighborhood.

Our strictures upon the observations of others may seem hypercritical, but when it is remembered that the only warrant for making any inference whatever is based upon the supposition that a similarity in the actions of insects to those of man, under a given set of circumstances, is the result of a similarity in their mental processes, it will seem scarcely possible to be too guarded in drawing conclusions.—*G. W. and E. G. Peckham.*

MICROSCOPY.[1]

Microtechnical Notes by Dr. Paul Mayer.—After describing the new water-bath and its accessories, Dr. Mayer proceeds to give the latest improvements in the methods employed at the Naples Zoological Station:

1. *The Section-Smoother, or Planisher.*[2]—The rod of the schnittstrecker, or planisher, as I shall call it, is not large enough to prevent very large sections from rolling a little. The defect is easily remedied by following the example of Vosmaer, who cuts off strips of the gelatin plates used by lithographers for tracing, and fastens them to the under side of the rod with very soft paraffine. In this manner the rod can readily be enlarged to any desired extent; and the transparency of the gelatin makes it possible to follow the sections as they pass under the rod.

2. *Section-Fixatives.*—Of the three fixatives now in general use,—shellac, collodion, and albumen,—shellac is considered the

[1] Edited by C. O. WHITMAN, Ph.D., Milwaukee, Wisconsin.

[2] "Schnittstrecker" has been variously translated "section-smoother," "section-stretcher," "section-flattener," etc. Perhaps the German name has been poorly chosen; at all events, our renderings of it are decidedly unsatisfactory names. The instrument is designed to prevent sections from curling; in other words, *to keep them plane*, or flat. The word *planisher*, taken in a strictly etymological sense, expresses the idea precisely enough, is both simple and intelligible. I venture, therefore, to propose it as a substitute for the awkward and clumsy compounds hitherto employed.

best for objects colored *in toto*. The carbolic-acid shellac introduced by Mayer has been found to be unreliable in some respects. Carbolic acid warm is injurious to some tissues,—*e.g.*, the dermis of vertebrates. The alcoholic solution is a perfectly harmless fixative. The method of using, which differs in important points from the one prescribed by Giesbrecht, is as follows:

a. The object-slide, heated to about 50° C., is coated with shellac in the usual manner, by drawing a glass rod wet with the solution once or twice over its surface. As soon as the slide is cool and the film of shellac hard and no longer sticky, the sections are arranged dry, and then gently pressed down by means of an elastic spatula (horn or metal) until they lie flat and smooth on the slide.

b. Expose the slide thus prepared to the vapor of ether. For this purpose the slide may be placed in a glass cylinder of suitable size, and closely stoppered. The cylinder is placed in a horizontal position, or, at least, so inclined that the slide lies wholly above the ether. The saturation of the sections will be sufficiently complete in about half a minute.

c. The slide is next to be warmed in the water-bath in order to evaporate the ether. The paraffine is then removed and the mounting completed in the usual manner.

It is best to use balsam dissolved in turpentine or benzole rather than in chloroform, as the latter softens the shellac, and thus often loosens the sections.

One great advantage of this method of using shellac is that it permits of *arranging and flattening the sections on the slide*. Ordinarily sections are placed while the adhesive coating is soft, and must then lie as they fall.

With reference to collodion, Mayer remarks that it depends entirely upon the *quality* of the gun-cotton employed whether the sections bear well treatment with alcohol and aqueous fluids. When sections are to be stained on the slide, the albumen-fixative is preferred to collodion. This mixture is prepared as follows:

White of egg	50 grm.
Glycerin	50 "
Sodium salicylate	1 "

These ingredients are mixed and thoroughly shaken together, then filtered and kept in a well-cleaned bottle. Mayer has kept this mixture three years in a good condition. Other antiseptics have proved far less efficient than salicylate of sodium.

3. *Sublimate*.—For the extraction of sublimate from tissues Mayer employs tincture of iodine. The tincture is added in small quantities to the alcohol in which the objects are preserved, as often as the color fades.

4. *Mayer's Carmine.*—This staining-fluid, previously described as "Alcohol Carmine,"[1] is a modification of Grenacher's acid carmine.

Carmine	4 grm.
Water	15 c.cm.
Hydrochloric acid	30 drops.
Alcohol (85 %)	95 c.cm.
Ammonia (enough to neutralize).	

The pulverized carmine is mixed with the water and the acid, and dissolved by boiling. The alcohol is then added, and the solution neutralized by stirring in ammonia until a precipitate begins to appear. This method of procedure is safer than the one hitherto followed, according to which the carmine was dissolved by boiling in the alcohol plus the acid.

5. *The Latest Camera Lucida of Abbe.*[2]—Zeiss makes two forms of the new Abbe camera lucida. Both are constructed on the same principle, but one (No. 70) has a larger mirror and a longer arm than the other (No. 69). The larger form—the one recommended by Dr. Mayer—is only made to order. The advantage of this form is that it enables one *to utilize the whole field of vision without any perceptible distortion of the image*, and is thus especially useful in drawing comparatively large objects with low powers. With the smaller camera (No. 69) the whole field can be projected on the drawing-paper only by giving the mirror an inclination differing so much from the angle (45°) required for accurate drawing that the image is more or less disproportioned.

The Abbe camera is superior to that of Oberhäuser in two important particulars: it gives a much larger field of vision and better light. Its construction does not admit of use with the microscope-tube in a horizontal position. This is a defect which ought to be at once corrected.

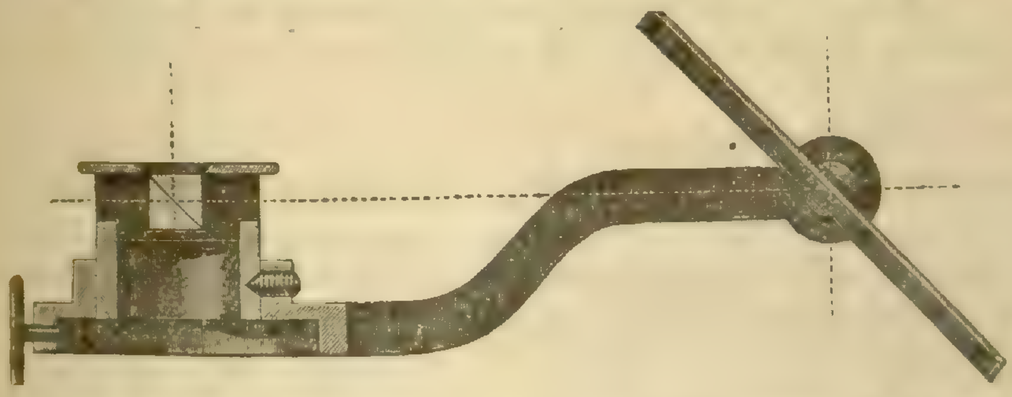
The Abbe cameras, especially the larger one, can be used to great advantage with the embryograph of His. It is only necessary to add to the stand a horizontal arm, to which the camera can be fastened.

The construction of the Abbe camera is illustrated in the accompanying cut.

The drawing-surface is made visible by a double reflection from a large plane mirror, and from the silvered surface of a small prism in the visual point of the eye-piece. The microscopic image is seen directly through an apparatus in the silvering of the prism. By the concentricity thus obtained of the bundle of rays reaching the eye from both the microscope and the paper, the image and pencil are seen coincidently without any straining of the eyes. With this apparatus, moreover, draw-

[1] Whitman, Methods of Research, etc., p. 39.
[2] Zeiss's Catalogue, 1885, p. 44, No. 70.

ings may be executed on a *horizontal surface without perceptible distortion.* The brightness of the paper is regulated by smoke-



tinted glasses which fit into the prism mounting. The apparatus is specially adjusted for the No. 2 Huyghenian eye-piece; mounted on this and fixed by a clamping screw the mirror only requires turning in the proper position and it is then ready for use.

SCIENTIFIC NEWS.

The Proposed Monument to Audubon.—At the recent meeting in New York of the American Association for the Advancement of Science, the fact that the remains of the great naturalist, Audubon, lie in an obscure and little-visited portion of Trinity Cemetery, New York City, and that his tomb is unmarked by any distinguishing monument, was brought to the attention of the members. The demands upon the time of all in attendance at that meeting were so great that no action was taken by the Association, although the most lively interest was expressed by individual members, and the propriety of marking the resting-place of the founder of American Ornithology by a suitable monument was appreciated.

The Audubon plot in Trinity Cemetery will probably be disturbed by the continuation westward of One Hundred and Fifty-third Street. The trustees of the cemetery have, with commendable liberality, assigned the Audubon family a new lot close to One Hundred and Fifty-fifth Street, in full sight of Audubon Park and near the end of Audubon Avenue, when this shall be continued from the north, and are in hearty co-operation with the monument enterprise.

At the first autumn meeting of the New York Academy of Sciences a committee was appointed to solicit funds and make all arrangements for a monument.

Vice-President Trowbridge then appointed as such committee Prof. Thomas Egleston, of the School of Mines, Chairman, Prof. Daniel S. Martin, of Rutgers Female College, and Dr. N. L. Britton, of Columbia College. This committee has organ-

ized with Dr. Britton as secretary and treasurer, and is now ready to receive subscriptions, which will be properly acknowledged. Checks should be made payable to N. L. Britton, Treasurer, and post-office orders should be drawn on Station H, New York City.

The committee estimates that between six and ten thousand dollars will be required to erect and engrave a shaft worthy the memory of America's first naturalist, and, while confident that this amount will be forthcoming, desires to have interest taken in the project by scientists in all departments in all portions of the country.

—Prof. A. H. Worthen has recently secured by purchase for the State Museum of Illinois four collections of Carboniferous fish teeth and spines, aggregating about two thousand specimens, which probably cannot be duplicated on this continent. It will be arranged for exhibition in the course of two or three months.

—Dr. M. E. Wadsworth has resigned the professorship of mineralogy and geology in Colby University, and has accepted the directorship of the Michigan Mining School. His address now is Houghton, Michigan, U. S. A. Exchanges are especially desired of papers relating to general and technical education, petrography, general and economic geology, mineralogy, crystallography, and meteorites.

—Professor Forbes's address, "The Lake as a Microcosm," has been printed in the *Bulletin of the Peoria Scientific Society* for 1887. In it are given generalizations based upon Dr. Forbes's investigations of the lakes of Illinois and Wisconsin.

—Prof. A. F. Marion, of Marseilles, has been elected a corresponding member of the Department of Anatomy and Zoology of the Academy of Science at Paris.

—Dr. H. Mayr, of Munich, has been appointed to the professorship of botany in the University of Tokio.

—Dr. Oscar Hertwig has been appointed ordinary professor of anatomy at Berlin, and Dr. G. Volkens has become a privatdocent in botany in the same university.

—Dr. A. Vöchting, of Basle, goes to the chair of botany in Tübingen.

—Recent Deaths.—Olry Terquem, student of Foraminifera, at Passy, aged ninety years; Dr. G. Grewink, Professor of Mineralogy at Dorpat, June 30, 1887, aged sixty-nine; Prof. L. G. de Koninck, the veteran palæontologist, at Lüttich, July 15, aged seventy-nine; Julius von Haast, the New Zealand geologist, aged sixty-two years.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Natural Science Association of Staten Island.—September 10, 1887.—Mr. Wm. T. Davis presented the following entomological notes: A little over a year ago, on July 3, while sitting on the piazza in the evening, I saw a *Calosoma scrutator* running across the floor. After a time it came to a stand-still and, lowering its body (for this beetle ordinarily carries it rather high), beat its antennæ, particularly the left one, rapidly on the boards. This made quite a loud, whirring noise that could have been heard many feet distant. I was sitting about two yards away from the insect, and it was very plain to me. I approached cautiously and watched it repeat the operation several times, but it finally ran to the edge of the piazza and flew off into the grass. A proceeding of this kind on the part of an insect is always interesting, as it indicates some mental activity. I have endeavored to make further observations on the subject, but no Calosoma in the proper frame of mind has yet afforded an opportunity.

On June 22 of this year I captured a female *Hyperchiria Io*, and, wishing to get some eggs, I put her in an old hat-box, thinking she would lay them there. There was, however, quite a small hole in the side of the box, and the moth, putting her body through it, laid all the eggs on the outside, thus choosing the lightest situation instead of the dark interior. The most amusing trait of the young caterpillars of this species is the soldier-like way in which they follow one another. I have watched them walking along a branch, the leader turning about when still some distance from the end, and all those behind uniformly followed that course, turning at the very same point.

In the Proceedings for October, 1885, I gave an account of how a chrysalis of the Monarch butterfly developed while pierced by a pin, the imago appearing in due time. I have since pierced some chrysalids of the cabbage-butterfly (*Pieris rapæ*), and they also brought forth perfect insects. One of these insects, when hatched, had the pin through the thorax as if transfixed in the perfect state. Of course, they are badly deformed, but it goes to prove what injuries may be inflicted upon them in nature, and they yet survive.

Two specimens of these butterflies were exhibited.

A preliminary list of the crustaceans of the island was presented by Mr. Ernest A. Congdon; also a list of the marine algæ from the shores of the island, by Mr. Nicolas Pike.

Dr. H. L. Carroll, on behalf of the Committee on the American Association for the Advancement of Science, reported that a successful excursion had been enjoyed to Sandy Hook, on August 15, in connection with the Torrey Botanical Club and the visiting botanists and entomologists of the association.

The American Ornithologists' Union held its annual meeting at the rooms of the Boston Society of Natural History, October 11 to 13, 1887. President J. A. Allen, of New York, occupied the chair. The secretary's and treasurer's reports were presented first, showing that the society had 25 foreign, 74 active, 46 associate, and 200 corresponding members. The foreign membership is limited to 25, the active to 100, the associate to 50, while the corresponding membership is unlimited in numbers. The treasurer's reports showed receipts of $1764, and expenditures of $1217. The council advised the incorporation of the Union under the laws of the State of New York. Some of the papers presented were of general interest and permanent value, while others were local lists of birds, and a few might even be enumerated as "cranky." Among the more prominent were, "An Account of the Life and Ornithological Work of the Late Prof. S. F. Baird," by Robert Ridgway, of the National Museum; "Cormorant Fishing in Japan," by P. L. Jouy; "A Bird-Wave," by Montague Chamberlain; "Nocturnal Migrations of Birds," by F. M. Chapman; "Minor Notes," by Colonel N. S. Goss.

The National Academy of Sciences held its autumn meeting at Columbia College, New York, commencing November 8, 1887. The following papers were read: "Seismoscopes and Seismological Investigations," T. C. Mendenhall; "On the Primary Specializations of the True Fishes," E. D. Cope; "A Study of the Behavior of Metals under Variations of Temperature," Wm. A. Rogers; "Chemism in its Relations to Temperature and Pressure," T. Sterry Hunt; "On the Mechanical Origin of the Structures of the Hard Parts of the Mammalia," E. D. Cope; "Progressive Series in Chemistry," T. Sterry Hunt; "Kilauea, a Basalt Volcano," J. D. Dana; "Circulation of the Sea through New York Harbor," Henry Mitchell; "On a Study of Color Contrast," Ogden N. Rood; "On the Relative Variability of Men and Women," W. K. Brooks; "On a New Form of Reproduction in Medusæ," W. K. Brooks; "On the Lucayan Indians," W. K. Brooks; "Experiments in Measurements of Statical Electricity in Absolute Units," A. M. Mayer; "On Potential as measured by Work: a Mathematical Discussion," A. M. Mayer; "A Comparison of Antipodal Faunas," Theo. Gill; "On a Discovery recently made in Connection with the Flight of Birds," W. P. Trowbridge; "On the Determination of Star Magnitudes by Photography," E. C. Pickering; "On the Constant of Aberration," A. Hall; "The Cretaceous Coals of Western North America," J. S. Newberry; "The Future of Gold and Silver Production," J. S. Newberry; "The Temperature of the Moon," S. P. Langley; "On a Method of making the Wave-Length of Sodium-Light the Absolute Standard of Length," A. A. Michelson and E. W. Morley.

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HOW THE GREAT NORTHERN SEA-COW (RYTINA) BECAME EXTERMINATED.

BY LEONHARD STEJNEGER.

THE conclusions in regard to the extermination of the Great Northern Sea-Cow (*Rytina gigas*) and the causes which led to it, arrived at by the Russian naturalists, Von Baer and Brandt, and by them discussed in numerous publications, were regarded as final, and were generally accepted, until Prof. A. E. Nordenskiöld recently made the startling announcement that, during his five days' stay at Bering Island with the "Vega," he discovered incontrovertible evidence that at least one sea-cow had survived the general slaughter, and had been seen alive as late as 1854, or more than eighty years after the last one was supposed to have been killed. This statement of Professor Nordenskiöld was based upon his interpretation of an account of a strange sea-animal which two Bering islanders claimed to have seen some time previously. Nordenskiöld gave no details to speak of, merely asserting that the description of the animal by the natives tallied so completely with Steller's description of the sea-cow as to leave no doubt that they had really seen a living Rytina; but, notwithstanding this meagreness of the account, the weight of Nordenskiöld's name was then so great that his assertion would probably have been generally accepted. It was my good fortune to spend a year and a half on Bering Island three years after Nordenskiöld's visit, and, as the readers of the "Proceedings of the United States National Museum"[1] will know, I succeeded in bringing to light a number of facts which

[1] Vol. vii., 1884, pp. 181–189.

prove conclusively—as I have published even the minutest details, any one can make up his mind as to the weight of the evidence—that the animal seen by the men was *not* a sea-cow, but that, in all probability, it was a stray female narwhal. To this Nordenskiöld has had no other reply than a reprint of his former assertion, without even an attempt to give any further details or to refute my arguments. The only new point in his answer is an effort to throw discredit on the accuracy of Sauer's "Account of Billing's Expedition in the Years 1785 to 1794," in which Sauer expressly states that the last sea-cow was killed at Bering Island in 1768, twenty-seven years after the island had been discovered by man. In a paper published in the *Bulletin of the American Geographical Society*[1] I have already been able to vindicate Sauer. In the present paper I shall, therefore, only try to demonstrate how easy it is to account for the rapid extermination of this huge animal, if we take all the known facts into consideration. To any one familiar with the literature on the subject such an undertaking might be supposed to be superfluous, so well has the task been performed long ago by the great Russian scientists already referred to; but I may perhaps be able to elucidate the subject a little further,—a labor apparently not quite unnecessary, in view of the following remarkable statement of Professor Nordenskiöld (*Bull. Amer. Geogr. Soc.*, 1885, p. 281): "It cannot very well be supposed that in a sea so rarely visited in the last century as the northern part of the Pacific Ocean the last specimen of the genus Rytina should have been slain by the harpoon of the hunter. I even imagine that the hardly accessible coasts of Bering and Copper Islands have been very rarely visited by hunters since Steller's day, 1741." As will be seen from the following pages, there was no need of "imagining" anything of the kind, when the facts, as related in the literature, so amply prove the contrary.

As everybody knows, Bering and his unfortunate comrades, among them the immortal Steller, in the autumn of 1741, discovered the then uninhabited island which afterwards received its name from Bering, who died there shortly after. The survivors of the expedition wintered on that island, and when they landed there they saw the first living sea-cows (Rytina) ever beheld by white men.

[1] 1886, No. 4, pp. 317–328.

Unfortunately, Steller, in describing this animal and its habits, only says that he found it numerous and in herds, without stating exactly how numerous or in how large herds. We are thus left to guess at their probable number when first found; and from what he says in regard to their habits and the places they frequented, and from what I know of the natural conditions of the island, I should regard fifteen hundred as rather above than below the probable number. It must be remembered that the sea-cow was an extremely bulky animal, twenty-four to thirty feet long, which lived chiefly near the mouths of the rivulets, feeding on the sea-weeds, especially the large Lamellarias. There are hardly more than fifteen places on the island which could afford them suitable grazing-grounds, and if each of these were regularly visited by an average of one hundred animals, one would easily be impressed by their number, especially if divided up into five to ten herds of from ten to twenty individuals.

There can hardly be any doubt that these animals were the last survivors of a once more numerous and more widely distributed species, which had been spared to that late date because man had not yet reached their last resort. It is, then, pretty safe to assume that this colony was not on the increase, and that, under the most favorable circumstances, the number of surviving young ones barely balanced the number of deaths caused by the dangers of the long winters. Under this supposition, every animal killed by a new agency—in this case by man—represents one less in the total number.

No sooner did the survivors of Bering's expedition return to Kamtschatka, in 1742, than hunting expeditions were fitted out; for already, in 1743–1744, we find Bassoff and his crew wintering on Bering Island, and from that year and until 1763 hardly a winter passed without one or more parties spending eight or nine months in hunting fur-animals there, during which time the crews lived almost exclusively on the meat of the sea-cow. But that is not all, for more than half of the expeditions which wintered there did so for the express purpose of laying in stores of sea-cow meat for their farther journey, which usually lasted two to three years more.

In order to substantiate the above assertion, I shall give a detailed list of the expeditions which are *known* to have wintered on Bering Island during the twenty years in question. The old

records are very defective, and it is extremely probable that many more of the expeditions which left Kamtschatka in order to hunt and trade on the Aleutian Islands and in America stopped at Bering Island, as was the usual custom; but we shall only enumerate those of which the records expressly say that they wintered there. The number of men employed on the vessels is not given in all instances, but, as it varies between thirty and fifty, I have estimated it to be thirty in most cases of which we have no definite record. In the few instances in which the length of time spent on the island is not given I have estimated it to be eight months, which is shorter than the shortest time actually recorded:

Winter.	Name of Owner or Captain of Vessel.	Men.	Months.	Remarks.
1743–1744..	Basoff.....	(30)	(8)	Numbers in parentheses estimated. Months, only approximate figures.
1745–1746..	Basoff.....	(30)	12	
1747–1748..	Kholodiloff...	50	9	There is some uncertainty about the time Yugoff spent on Bering Island. He is said to have wintered from 1751 to 1754 on Bering and Copper Islands,—about thirty-two months. It is not probable that he spent less than half of this time on Bering Island.
1748–1749..	Bakhoff.....	(30)	11	
1749–1750..	Tolstykh.....	50	8½	
1751–1752..	Yugoff.....	26	(16)	
1752–1753..				
1753–1754..	Kholodiloff...	34	10	
1754–1755..	Drushinin....	(30)	(8)	
1754–1755..	Durneff.....	(40)	(8)	These four men belonging to Drushinin's crew were left behind.
1754–1755..	Krassilnikoff.	(30)	9½	
1754–1755..	Jakovleff.....	33	(6)	
1755–1756..	.....	4	.....	
1756–1757..	Krassilnikoff.	(34)	(8)	Krassilnikoff's crew and four of Drushinin's.
1756–1757..	Tolstykh.....	38	9	
1757–1758..	Shilkin.....	39	(8)	
1758–1759..	Paikoff.....	45	9½	
1760–1761..	Tolstykh.....	(38)	8½	
1762–1763..	Korovin	45	9½	
1762–1763..	Medvedeff....	45	(9)	

It will be seen that there wintered in 1754 to 1755 about one hundred and thirty-three men, and in 1762 to 1763, ninety men.

In addition to the above, we know of a number of expeditions wintering on Copper Island, and many more which passed by the Commander Islands on their way east. Besides, how many were there of which we know nothing? And yet Professor Nordenskiöld imagines that these islands "have been very rarely visited by hunters since Steller's day,—1741"!

Some of the records in regard to the above expeditions are

very interesting as having a direct bearing on the question before us. Thus, it is said, *à propos* of Krassilnikoff's wintering on Bering Island, that "it had already become customary for all vessels intending to hunt sea-otters on the more distant islands to winter there [Bering Island] in order to provide sufficient stores of the meat of the sea-cows (*Manati*)." These expeditions lasted usually three to four years, and it is safe to assume that they laid in provision for not less than twelve months. Of the expeditions enumerated in the above list, ten, with an aggregate of about four hundred men, belong to this category.

Still more valuable are the details which have been recorded in regard to Jakovleff's expedition. He was a mining engineer, consequently a man of education and intelligence, as his reports also testify, sent out by the Russian government in order to investigate the alleged occurrence of native copper on Copper Island. The records show, beyond dispute, that when this island was first visited (1745 to 1746) sea-cows occurred along its beaches (and I myself have found remains of them on that island); but in 1754, when Jakovleff was to explore Copper Island, he was obliged to winter on Bering Island, *because at that early date, nine years after the first visit, the sea-cows had been extirpated on Copper Island by man!*

Including his crew, there wintered that year, on Bering Island, hardly less than one hundred and thirty-three men, one of the chief occupations of whom it was to procure, during eight months, as much sea-cow meat for their future expeditions as they possibly could. This was done regularly by harpooning the animal from a boat manned with eight oarsmen, and when killed it was immediately towed to the shore to be hauled up on the beach and cut up at once, as the meat would spoil if left unattended until the next day. This was the method for securing provisions for the vessels, but a much more wasteful manner was pursued in killing the animals which served as food for the hunters during their sojourn on the island. From Jakovleff's diary we learn that the hunters were scattered all over the northern (*i.e.*, northern and eastern) shore of the island by twos and threes for the sake of catching foxes and other fur-animals, while sea-cow meat was the only food available.[1] These

[1] It is even probable that Jakovleff refers to a more or less regular population of hunters, in addition to the crews of the wintering vessels.

men, in order to obtain food, had to secure their sea-cow single-handed, and whenever they got an opportunity—what they often did—they would sneak up to an animal lying close to the shore or in shallow water, and wound it mortally by thrusting the iron-shod pole into it. The animal, which was hardly ever killed outright, sought the high sea and died there. If it drifted ashore the same day, well and good; but in most cases it came in unfit to be eaten, if it was not carried away altogether. So impressed was Jakovleff with the extreme wastefulness of this method that he predicted the speedy extermination of the sea-cow unless some precautions be taken against this senseless slaughter; and when, in 1755, he returned to Kamtschatka, he presented a petition to the authorities there that it be prohibited by an ukas to kill sea-cows in this manner, "in order that Bering Island may not be devastated in the same manner as Copper Island." Of course, nobody heeded this eminently wise suggestion, and the result became as he had predicted it: the last sea-cow was killed within thirteen years.

Can anybody who contemplates the fact that the sea-cow was an exceedingly stationary animal, which was bound to the kelp-fields near shore; that it was extremely stupid and sluggish; that it was deprived of the faculty of diving; and that the island offers absolutely no shelter or concealment for it,—can anybody, after having read Jakovleff's report and petition, possibly entertain a doubt that the last specimen of the genus Rytina was slain by the harpoon of the hunter?

But let us attempt a calculation, based upon the former guess as to the original number of living sea-cows when Bering Island was first visited, and upon the facts as they have been presented above. Before doing so we will have to estimate the number of animals wastefully slaughtered, and from the statements made by Jakovleff I should think it no exaggeration to say that there were killed five times as many animals as were actually utilized. From Jakovleff's report we learn that one sea-cow would furnish food sufficient for thirty-three men during a whole month, and, although it is probable that he made his party utilize each animal in a higher degree than the other hunters, we shall take the above figures as indicating the average. It will be seen that we do not take into account Burdukovski's statement, that only the kidneys were eaten, for he only had his knowledge from hearsay,

while from Jakovleff's diary it seems evident that all the meat was eaten. This is an additional reason why no weight should be attached to the rest of Burdukovski's story.

Now, to supply the six hundred and seventy men which we know wintered on Bering Island between 1743 and 1763, during an average time of ten months, it required, in round figures, about two hundred and five animals. According to the same method of calculation, we find that the four hundred men who laid in provisions for protracted journeys would require about two hundred and ninety animals for an average time of twenty-four months,—together, four hundred and ninety-five animals. If five times as many cows were wantonly killed as were utilized, we have a grand total of two thousand four hundred and seventy-five sea-cows slaughtered up to the year 1763, or nearly one thousand in excess of our estimate of the original number. We can therefore either admit that there were more than two thousand living sea-cows when Steller discovered them, or else that only twice as many animals were wasted as were properly utilized; but, whatever conclusion we choose, it is manifest that our estimates have been very reasonable.

From 1763 the visits to Bering Island seem to grow scarcer; at least, the records contain nothing definite that I am aware. This is probably due to the very fact that sea-cows had now become so nearly exterminated that the few left were insufficient to maintain any wintering and foraging expedition, while, at the same time, the fur-bearing animals were also so badly decimated that it would not pay for a large party to hunt them. The smaller animals, as we know, would recuperate when left undisturbed for a few years, and it was probably by a party who went out to Bering Island in 1767 or 1768—possibly on one of Popoff's vessels—in order to catch blue foxes that the last sea-cow was mercilessly killed. Four years after, in 1772, Dmitri Bragin again wintered on Bering Island, and, from the fact that in the list he gave of the animals of the island he omitted the sea-cow, it is reasonably safe to conclude that not one was left to be recorded by him.

After all, there is nothing surprising in the speedy extermination of this clumsy animal, which could not dive, and which had actually no means of defence or escape. It is too well known that it did not emigrate, and the theory that it was driven off to

other places is not only directly disproved, but is quite unnecessary in order to explain the sudden disappearance of the Great Northern Sea-Cow from the shores where it was first discovered.

I think it will be admitted that we have succeeded in materially strengthening Sauer's assertion, that the Rytina was exterminated in 1768, and that the above is a fair exposé of the causes which led to its final extirpation. It was simply due to man's greed, and he accomplished it within the short time of twenty-seven years.

THE MATERIALS OF THE APPALACHIANS.

BY E. W. CLAYPOLE.

(Concluded from page 962.)

The Four Great Sandstones of Pennsylvania.

IN the former part of this paper I dwelt on the fact of the existence of several thick sandstones and quartz conglomerates in the massive palæozoic deposits of Pennsylvania. I further showed that these rocks indicate a supply of quartz far greater than could be furnished from any existing source; and, thirdly, that the nature of this quartz is such that the only known origin for it is the quartz-ledges of the South Mountains. Hence I inferred the former extension of these strata over a greater extent of country than at present.

In this second part I propose to try and give a more definite shape to this conclusion, and to at least suggest where and when this palæozoic land existed.

Excluding, for various reasons which it is not necessary here to mention, the Potsdam Sandstone, there remain four great sheets of sandstone, more or less conglomeratic, in the immensely thick palæozoic deposits of the Eastern States. Between them there lie massive, softer deposits of shale and limestone. In descending order these beds are as follows, omitting all minor and insignificant layers:

		Feet.
	Shale, coal, sandstone	Variable.
4	Sandstone and pebbles (Pottsville Conglomerate)	1500
	Shale (Mauch Chunk)	1500
3	Sandstone and pebbles (Pocono Conglomerate)	2000
	Sandstone and pebbles (Catskill Sandstone)	6000

		Feet.
	Shale and limestone (Devonian)	4000
2	Sandstone and pebbles (Oriskany Sandstone)	300
	Shale and limestone (Lower Helderberg, etc.)	300
1	Sandstone and pebbles (Medina, Oneida, etc.)	1500
	Shale and limestone (Trenton, etc.)	5000
	Sandstone (Potsdam)	400

Here are four vast beds of sandstone, all more or less conglomeratic, lying between thick masses of softer rocks. In ascending order they are the Medina, the Oriskany, the Catskill-Pocono, and the Pottsville. They vary in hardness, in thickness, and in coarseness, but they all agree in being composed of almost nothing but quartz in the form of pebbles and of sand.

Now, we are quite safe at the outset in asserting that these four great sandstones, with their alternating shales, represent as many changes in the conditions of deposition. The geographical arrangement of land and water that allowed the deposition of shale would prevent that of sandstone. Results so different argue different causes. Regarding the origin of the shales I do not now propose to inquire, and will therefore dismiss them without further notice, and refer only to the four great sandstones already mentioned.

It is obvious that each of these implies the destruction of an equal amount of rock elsewhere. They were not made from nothing. Inch by inch and pound by pound they and their pebbles represent and measure the rock whence they were hewn. So vast an accumulation of quartz, therefore, implies an equally large quarry from which it was obtained. But no such quarry exists; it has entirely disappeared.

Again, these four sandstones in succession imply not one but four quarries, and the consent of geologists is universal that these quarries must have been in the East; that this sand and these pebbles have travelled to the West and the Northwest.

I am inclined, therefore, to read in these four sandstones a record of changes which the eastern part of the country underwent during the palæozoic era. Reasoning back from the effect to its cause, I think we may see in them a history of what was occurring elsewhere during their formation.

Where, then, shall we seek the Eastern quarry of quartz-rock from which the massive Medina Sandstone was derived? It

seems to me that in this great conglomerate mass we have a record of a lost quartz-ridge or reef that existed in Middle Silurian days, but which long ago disappeared,—a reef of rock like that which now forms the ledges of the South Mountains; a ridge large and enduring enough to furnish all the sand and pebbles required, though the Medina is, in some places, two thousand feet thick.

Nor is the existence of such a lost ridge along the Atlantic sea-board altogether imaginary. We know that in later days a force has acted in the same region that was fully capable of producing such a result; and we have no reason to assume that the tangential pressure which at the end of the palæozoic era crumpled the crust and raised the Appalachian arches acted then for the first time. The grand catastrophe which shaped our Eastern States and closed the palæozoic era in North America may have been not its first, but its final, manifestation, and may have been preceded by others of equal, or even of greater, intensity. It is by no means unlikely that the same force that raised the Allegheny Mountain arches also raised, in Mid-Silurian days, a similar arch of the hard, semi-crystalline rocks like those of the South Mountains, from whose wreckage the Medina Sandstone was made. As it rose it was torn down by the waves, its quartz dispersed, and a new rock formed at a lower level.

A time of rest ensued. The deposition of quartz ceased and the Upper Silurian rocks were formed. But the resting stage came to an end and the earth-force again manifested itself. New crumplings set in and a new ridge was elevated, which we may call the Oriskany Ridge, as from its material the Oriskany Sandstone was probably formed. This, though thin when compared with the massive Medina, covers an equal or a greater extent of country, and in material the two can scarcely be distinguished.

Rest again ensued, and the formation and deposition of sand and pebbles again ceased. The huge beds of the Lower and Middle Devonian were formed, and meanwhile the pressure was accumulating for another thrust.

At last it came. The long pent-up force overcame the resistance. Another time of disturbance set in. Another part of the Archæan area was brought within the denuding force of the waves. Sand and pebbles were again formed, and the thickest

quartz-bed of the whole series was laid down. Judging by its effects this was the most extensive disturbance of the four. It formed a bed of sandstone reaching in some places a thickness of seven thousand feet, for the Catskill and the Pocono united sometimes surpass even these enormous figures. This implies immense erosion elsewhere, and the inference seems quite just that this Catskill-Pocono Ridge formed a conspicuous or an enduring feature in the Upper Devonian landscape.

But it disappeared and a time of inaction followed, marked by the deposition of numerous soft beds on the eastern sea-board and in the midland basin. These are now the Lower Carboniferous Rocks. Again the compressing force overcame its resistance and a fourth ridge arose, whose destruction in due course furnished the material of the Pottsville Conglomerate, underlying the Coal-Measures. The manufacture of quartz-sand and of pebbles again began, and a sheet of this material was spread over Western Pennsylvania, West Virginia, and Ohio, gradually diminishing in thickness and in size as it recedes from the parent reef. On this, when the stock of quartz was exhausted, were laid down the coal-beds, with all their intermediate limestones, shales, and sandstones.

Such, as I read it, was the history in brief of these four sandstones. I have omitted all details, all minor beds, and have touched only the great features of the story. Four acts in the drama are now complete, and the fifth and last follows in due course.

No trace remains of the four elevations above mentioned except the four monumental sandstones built up from their remains. But the case is different with the last. This was the great earth-thrust that occurred at the close of the Carboniferous period. Then the suspended force again came into action, and the newly-formed coal-beds were crushed and crumpled into the arches and troughs in which their remains now lie. Of this latest catastrophe abundant traces remain. The ridges then formed have not yet disappeared, and all the ranges of Pennsylvania, with the possible exception of the South Mountains, date their beginning to that event. This last act in the drama is one of the great facts in American geology. It is the greatest epoch in the history of the continent. The Appalachian Revolution closed the Palæozoic era and lifted North America above the waves of the ancient sea.

We need, therefore, only extend backward a known process to explain the origin of these four sandstones. We can in imagination see a series of ridges rising one beyond another in time gone by on what is now Eastern Pennsylvania. We see these ridges destroyed as, or after, they arose, and we see their wreckage forming new strata at a lower level. Extinct mountains, we may call them, which have passed away and left no trace on the face of the earth save the four great sandstones which form their monuments.

The wide plains of Eastern Pennsylvania were the standing-ground of these ridges. An extension of the quartzy strata of the South Mountains over this district where the mica-schists of the Archæan are now exposed, the successive crumpling of these strata and their subsequent erosion, complete the picture. Abundant material was obtainable, for we must be careful not to limit the area to its present size. Crumpling causes compression, and the site of Philadelphia must have then been much farther from that of Harrisburg than it now is.[1] The Archæan terranes east of the South Mountains were then deeply buried beneath later deposits since removed. Each successive area of crumpling from east to west became compressed beyond all further compression, and then added itself to the compressor, thus aiding to shove forward the adjoining area just as layer after layer of snow is added in front of a snow-plough until the resistance becomes great enough to stop the engine.

In the consideration of this subject the geologist is often puzzled to find a transporting force sufficient to distribute this sand and these pebbles over so great an area. From the ridges whence they were derived they have been strewn over the country to the westward for five hundred miles, in sheets of remarkable evenness, gradually thinning out as the distance from the quarry increases. The Oriskany is especially remarkable in this respect. It extends over the whole area above named, and over parts of New York, Maryland, and West Virginia, forming a bed of almost unbroken continuity, but seldom exceeding two hundred or three hundred feet in thickness. To what power can we attribute the formation of so thin and yet so broad a sheet?

Without dogmatizing on this difficult subject, there is one

[1] See American Naturalist for March, 1885.

suggestion which I wish to make. It may be of some use in explaining the phenomena, and it may not. I am disposed to attribute it to the tide, whose forced wave, sweeping every day over the successive ridges or through the successive archipelagoes which I have described, tore away the rocks and swept the fragments westward, rolling them over and over against one another until they were ground to pebbles and to sand. The tide-wave reaches the bottom of the deepest water, and is not a mere superficial current. Its motion is incessant, twice a day, and not occasional as that of the storm-wave. Finally, its direction in this region was westward, and it is a fact of no little significance, in this connection, that, so far as we can determine, all the material of these four sandstones has travelled westward.

These considerations united induce me to believe that the tide-wave was the chief agent in their formation; that, rolling, as it did, every twelve hours from the East into the midland ocean of North America, through the successive archipelagoes or reefs which I have here attempted to describe, it acted as a grinding and transporting engine of transcendent power to fashion and to carry the sand and pebbles of which our great conglomerates consist.

There is nothing, so far as I am aware, in the rocks that is incompatible with these views. It is well known that the conglomerates are thicker and coarser in the East than in the West, and that there also pebbles of slate and other softer minerals are more abundant. Only the very hardest material—the quartz—could survive the wear and tear of so long and so rough a journey, and accordingly in the West this material constitutes the whole mass of the rock.

One other point should be at least alluded to. Recent researches have rendered it probable that this great grinding engine, this tide-wave, was more powerful then than now; but on this I do not care to insist. Sir Robert Ball's immense six-hundred-foot tide-wave must, I think, be relegated to a much earlier date. Yet the theory is entitled to whatever advantage may be derived from the greater tides of palæozoic time.

Should the suggestions here made and the views here advanced, regarding the origin and formation of the Conglomerates of Pennsylvania, prove to be of any value, they may indirectly bear on the moot question of the antiquity of the Atlantic

Ocean; for, if the transportation of the pebbles and sand was really due to the tide, it would indicate the existence of an Atlantic basin in pre-palæozoic days, from which the forced wave flowed over or through these successive reefs or ledges into the midland basin.

THE PERISSODACTYLA.

BY E. D. COPE.

(Concluded from page 1007.)

THE CHALICOTHERIIDÆ had numerous representatives during Eocene time, and a few species of Chalicotherium extended into Miocene time. The boundaries which separate the family from the Lophiodontidæ on the one hand and the Menodontidæ on the other are not always easy to determine. From the former the symmetrically-developed external V's of the superior molars and the double V's of the inferior molars distinguish it; yet in Pachynolophus the anterior cingular cusp produces a part of the

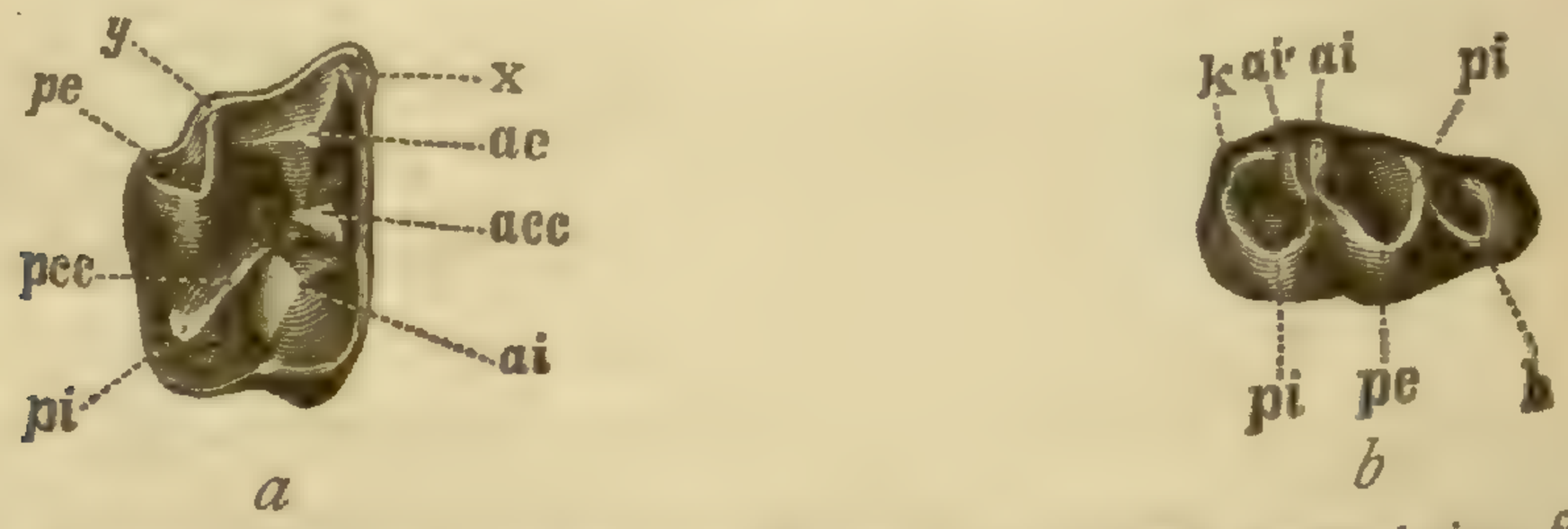
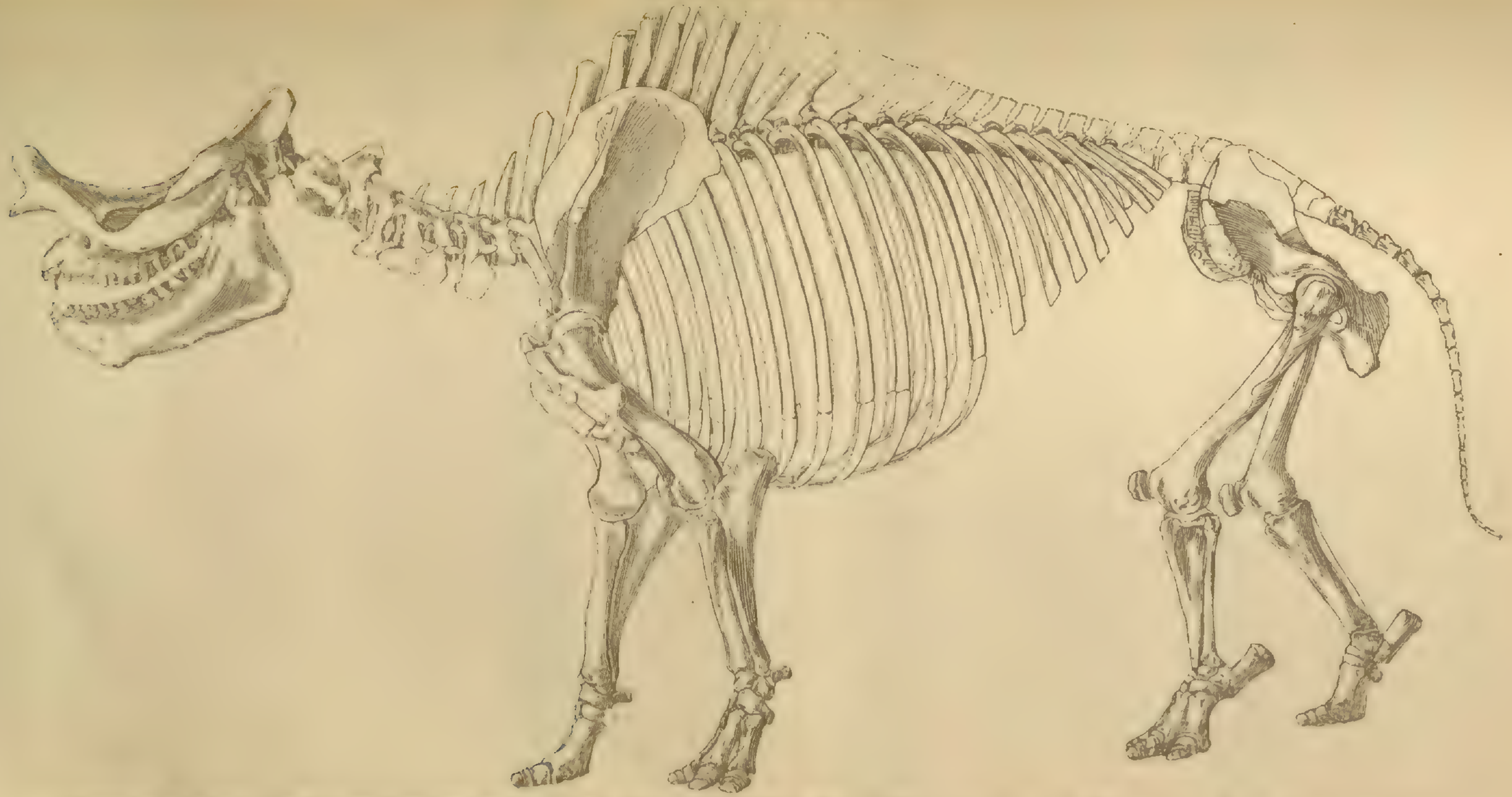


FIG. 24. *Lambdotherium popoagicum* Cope, molar teeth, natural size; from Wind River Eocene of Wyoming. From Wortman, after Cope. Fig. *a*, second superior molar; *b*, last inferior molar. *ae* and *pe*, anterior and posterior external V's; *y*, intermediate external rib; *x*, anterior external angle; *pi* and *ai*, anterior and posterior internal tubercles; *acc* and *pcc*, anterior and posterior intermediate tubercles; *h*, heel.

asymmetry found in the Lophiodontidæ. The character of the double inner cusps of the superior premolars, which distinguishes the Menodontidæ, is only found in the last premolar in Diplacodon of the latter, while a trace of the additional cusp of this tooth is found in the Chalicotheroid Nestoritherium.

In using the following table it must be borne in mind that the structure of the feet has not been determined in several of the genera:

PLATE XXXII.



Menodus giganteus Leidy, one-twenty-fourth natural size; from White River (Oligocene) bed of Nebraska. From Scott and Osborn, in Bulletin Mus. Compar. Zoölogy, Cambridge, Mass.

I. Internal cones of superior molars separate from external lobes.

A. External tubercles subconic, separated by a vertical external tubercle.

Fourth inferior premolar like first true molar;.....*Ectocium* Cope.

Third and fourth inferior premolars like the true molars;...*Epihippus* Marsh.[1]

AA. External tubercles of superior molars become V's, which are separated externally by a vertical ridge.

a. Incisors present.

β. No diastema in front of second inferior premolar.

Second premolar without inner lobe; last molar with one inner cone;.....*Leurocephalus* S. & O.

Second premolar with inner cone; last superior molar with an inner cone;.....*Palæosyops* Leidy.

Second premolar with inner cone; last superior molar with two inner cones; .....*Limnohyus* Leidy.

ββ. A diastema in front of second inferior premolar.

Two inner cones of last superior molar;.....*Lambdotherium* Cope.

aa. Incisors absent from both jaws.

Last superior molar with one internal cone;.....*Nestoritherium* Kaup.

II. One or both internal cusps of superior molars united with the external lobes by cross-crests.

a. External cusps of superior molars more or less conic.

An antero-external cingular cusp;.....*Pachynolophus* Pomel.

aa. External lobes of superior molars, inflected V's.

β. No crescentic inner lobes.

Intermediate lobes confluent;.....*Chalicotherium* Kaup.

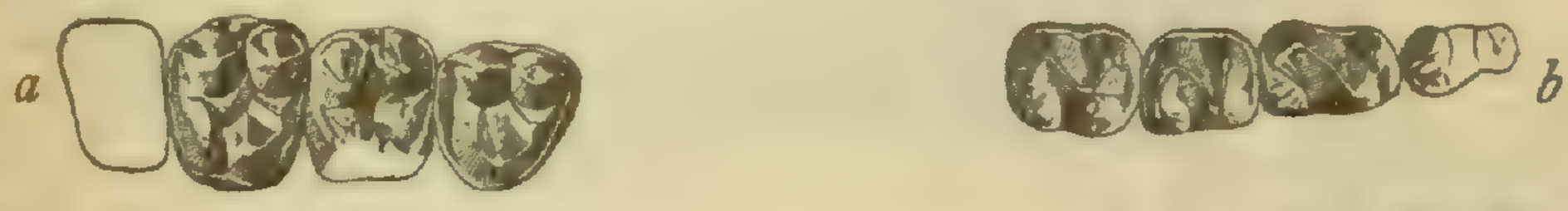


FIG. 25. *Ectocium osbornianum* Cope, molars, natural size; from the Suessonian of Wyoming. Fig. *a*, superior molars; *b*, inferior molars. Original.

FIG. 26. *Lambdotherium popoagicum* Cope, lower jaw ramus, natural size; from Wind River Eocene of Wyoming. Original.

The phylogeny of this family is not difficult to read. Ectocium, if it be truly a member of it (the feet are unknown), is clearly the primitive genus, which is not far removed from Systemodon of the Lophidontidæ, in characters. The flattening of its external cusps produced the two external V's of the other genera, and this, without further modification, would give us Leurocephalus and Palæosyops, the former having the second superior premolars more simple than in the latter. This type,

[1] Teste Scott and Osborn.

with diastemata, is Lambdotherium. The same type, without incisors, gives us the Asiatic Nestoritherium. The development

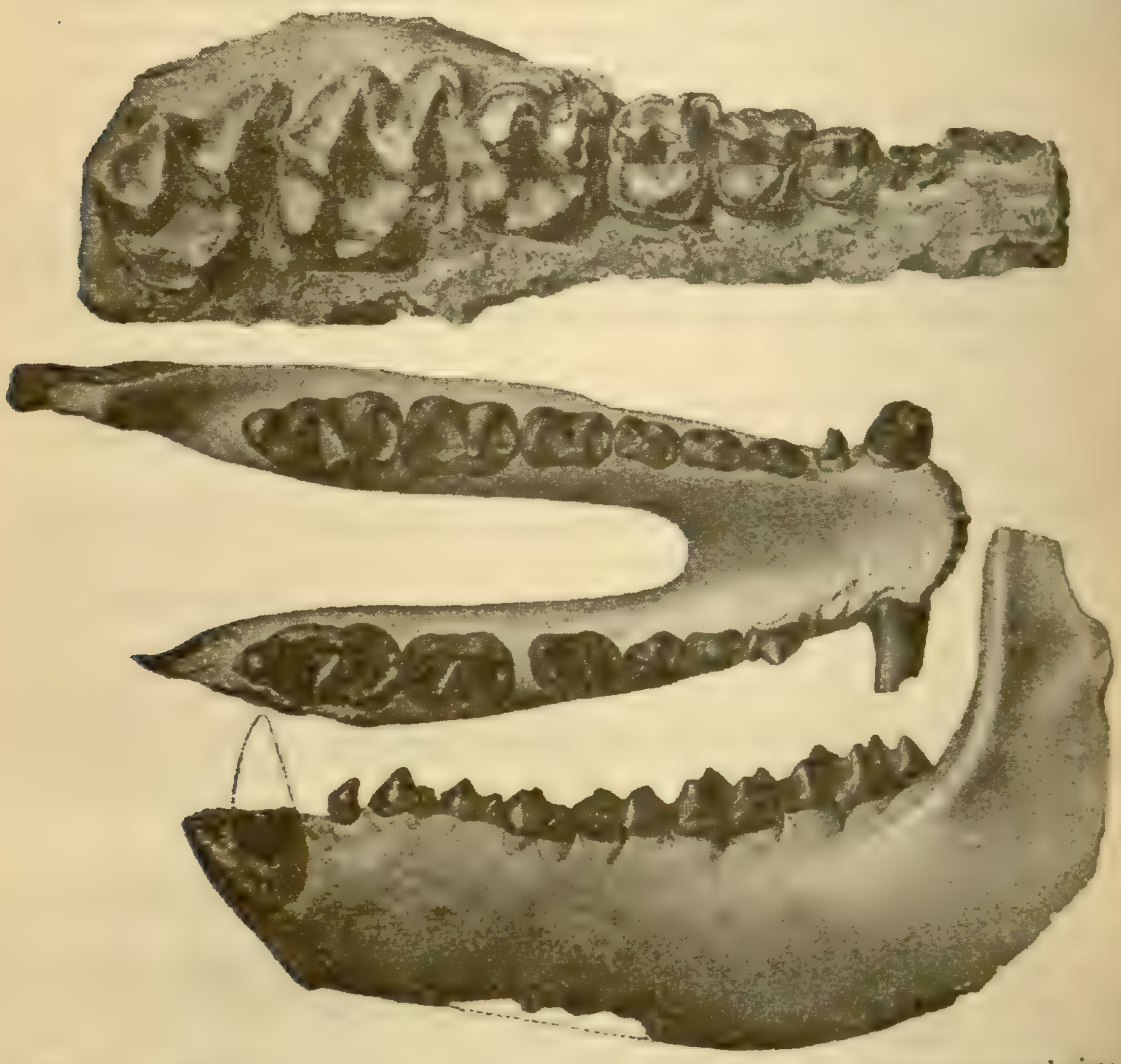


FIG. 27. *Palæosyops major* Leidy, superior molar teeth, one-half natural size; after Cope. From the Bridger Eocene of Wyoming.

of cross-crests is accomplished, as in other families, by the compression and fusion of the intermediate and internal tubercles. When the external V's are little pronounced, we have Pachynolophus; when they are well developed and the anterior inner tubercle remains distinct, we have the genus Chalicotherium. These relations are probably phylogenetic, and may be represented as follows:

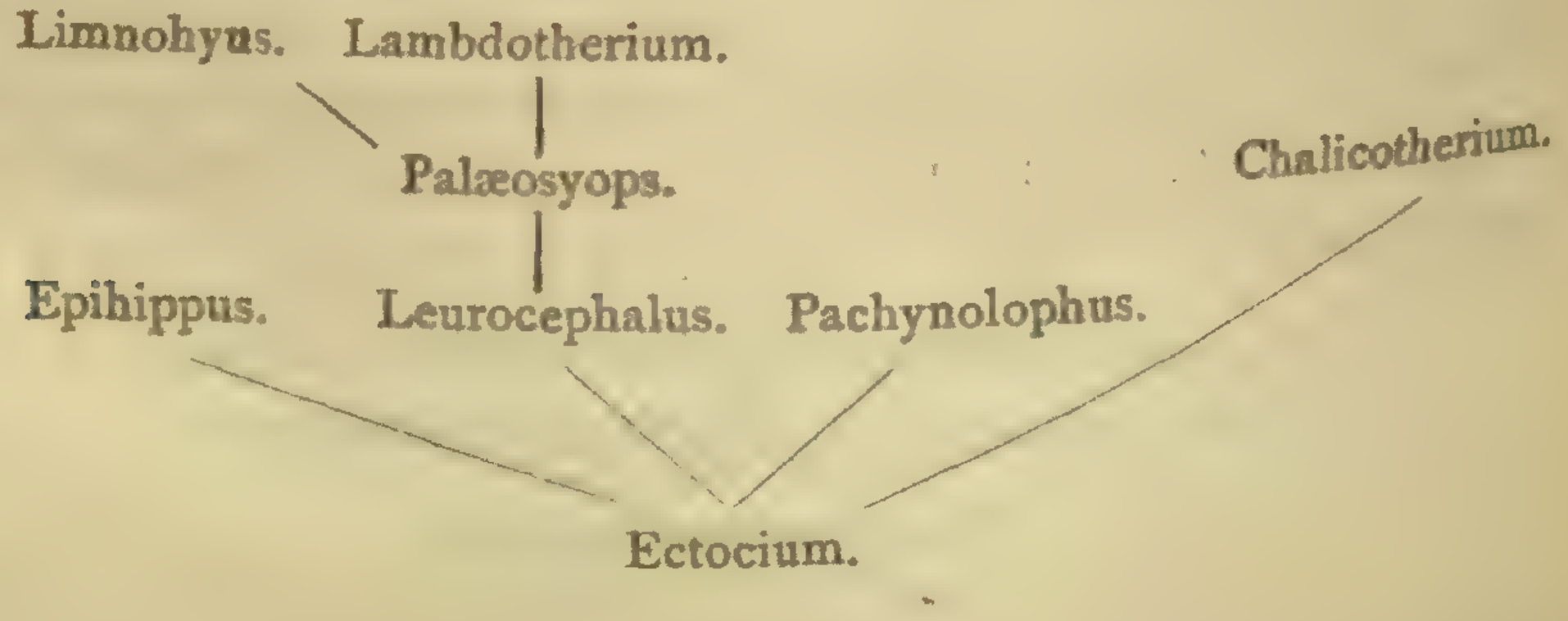


PLATE XXXIII.

a

Limborodon altirostris Cope, skull, one-sixth natural size; from the White River Miocene of Colorado. From Ann. Report U. S. Geol. Surv. Terrs., 1873.

b

Limborodon bucco Cope, skull from below, one-sixth natural size; from the White River bed of Wyoming; from Ann. Report U. S. Geol. Surv. Terrs., 1873.

The known genera of MENODONTIDÆ are all American. They differ as follows:

a. Last superior premolar only with two inner tubercles.
Incisors present; no horns on the muzzle;.....*Diplacodon* Marsh.
aa. All the superior premolars with two interior cusps.
Six inferior incisors; canines very large;.....*Dæodon* Cope.
Six inferior incisors; canines very small; horns on the muzzle;...*Menodus* Pomel.
No inferior, and four small superior incisors; canine very small; horns on the muzzle;.....*Symborodon* Cope.

Diplacodon, in its simpler premolars, approaches the Chalicotheriidæ, and is the oldest of the American genera. It is from the Diplacodon bed or Upper Eocene. Menodus and Symborodon, which include some species of gigantic size, belong in the White River or Oligocene, while Dæodon has, so far, only been obtained from the John Day or Middle Miocene. The phylogeny of the family is simple, as Diplacodon is clearly the ancestor of Dæodon on the one hand and Menodus on the other. Menodus in time, by the loss of its incisors, gave origin to Symborodon. This line left no representatives later than Miocene time. If Epihippus enters this family, it may be the parent of Mesohippus of the next higher horizon, the White River Miocene (Oligocene).

There are numerous species of the genera Menodus and Symborodon, and they are among the most remarkable of Mammalia. They are readily distinguished, among other characters, by the form of the horns. In one group of species they are round except at the tips, and are greatly elongated; in another they are sub-round or slightly compressed; in a third type they are short and trihedral; in a fourth type they are much compressed and expanded transversely; and in a fifth they are of insignificant size. Four of these types exist in both genera. They may be compared as follows:

Group 1.	Group 2.
Menodus.....*M. dolichoceras* S. and O.	*M. coloradoensis* Leidy.
	M. giganteus Leidy.
	M. tichoceras S. and O.
	M. angustigenis Cope.
Symborodon...*S. acer* Cope.	*S. altirostris* Cope.
	S. bucco Cope.

Group 3.	Group 4.	Group 5.
Menodus.....*M. ingens* Marsh.	*M. platyceras* S. and O.	
Symborodon...*S. trigonoceras* Cope.		*S. heloceras* Cope.

FIG. 28. *Symborodon acer* Cope, skull without maxillary and zygomatic bones, one-fifth natural size; left side; from White River beds of Colorado. Original. From Ann. Report U. S. Geol. Survey Terrs., 1873.

FIG. 29. *Symborodon trigonoceras* Cope, skull from above, one-tenth natural size; from White River bed of Colorado. Original; from "Report U. S. Geol. Survey Terrs." (unpublished).

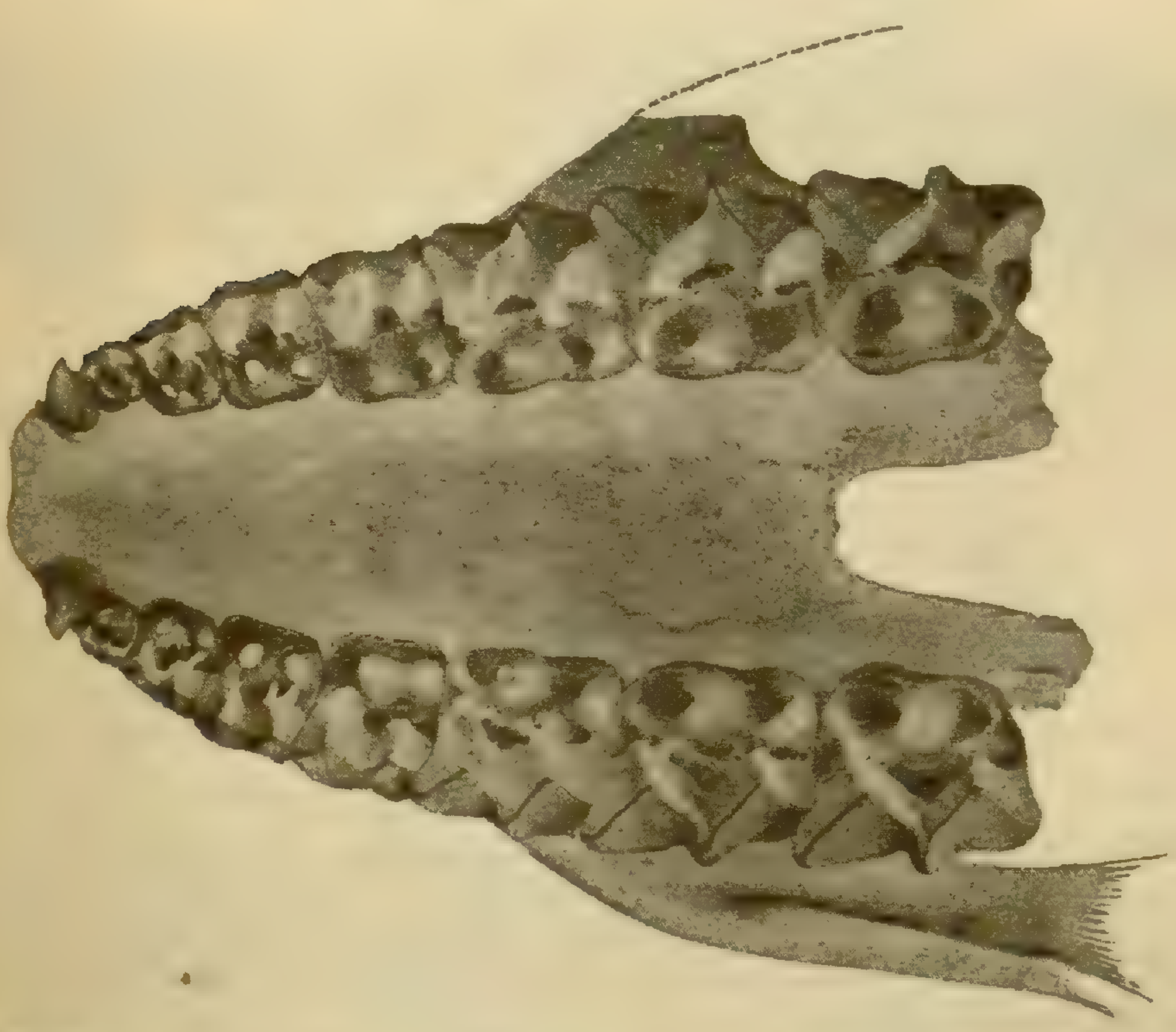


FIG. 30. *Symborodon trigonoceras* Cope, palate and teeth, one-fifth natural size; from White River bed of Colorado. From a different specimen from that represented in Fig. 29. Original; from "Report U. S. Geol. Survey Terrs." (unpublished).

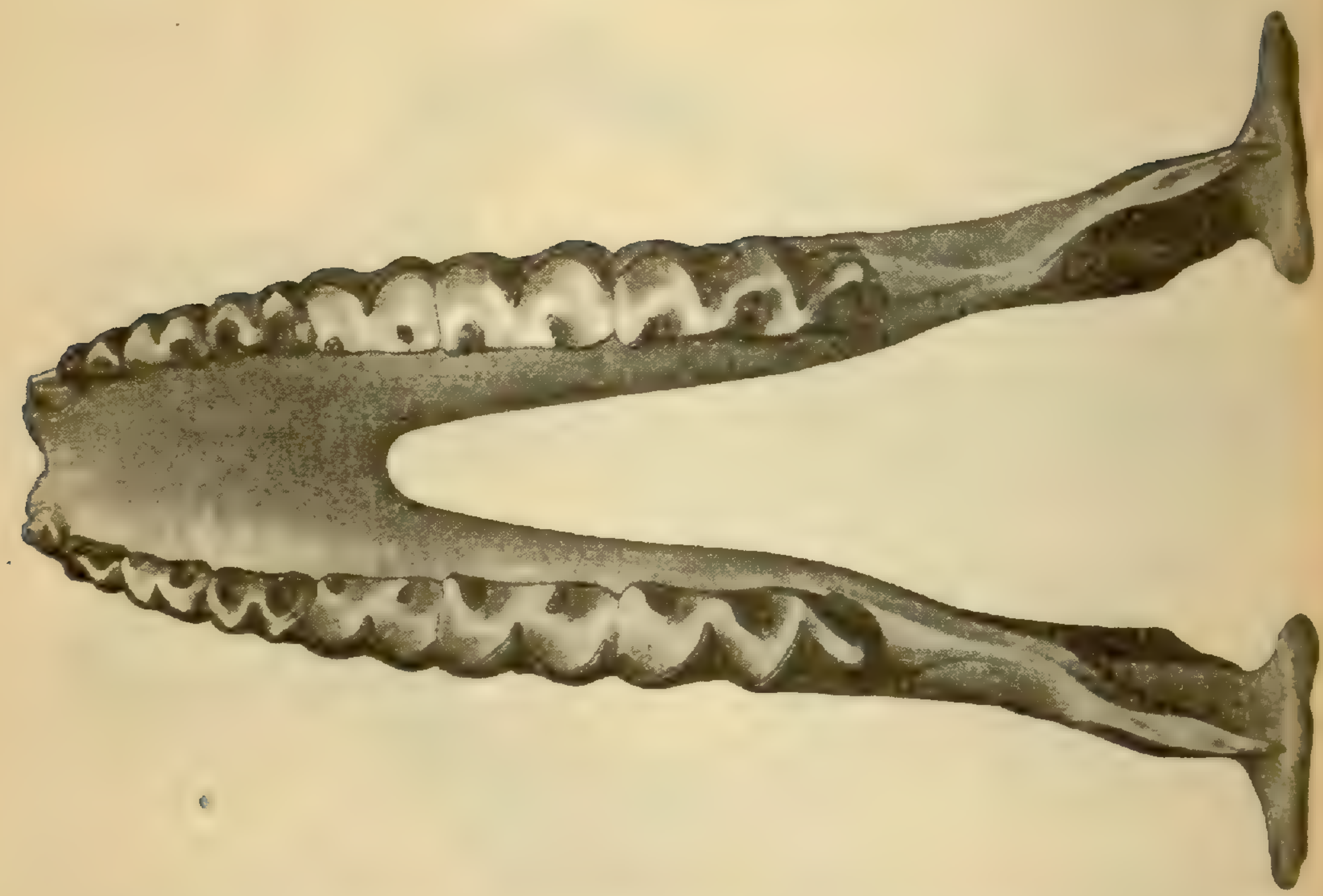
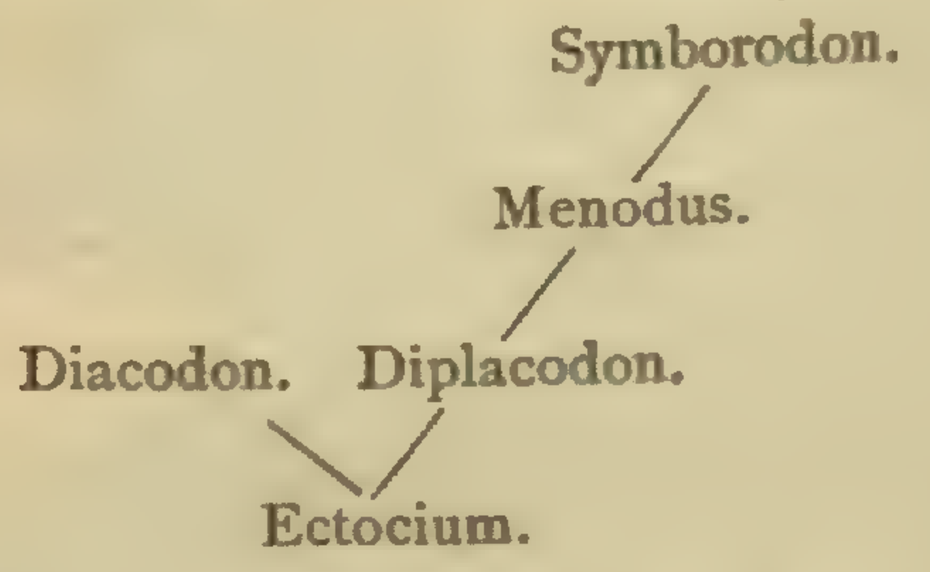


FIG. 31. *Symborodon trigonoceras* Cope, lower jaw from above; from White River beds of Colorado; one-fifth natural size. Original; from "Report U. S. Geol. Survey Terrs." (unpublished).

Transitional between the two genera is the *Menodus angustigenis* Cope, from the White River bed of Canada, which has the lower incisors of Menodus, with the narrow symphysis of the known species of Symborodon. The phylogeny of the family can be thus represented:



A genus, probably of this family, has been described from Transsylvania, under the name of Brachydiastematherium, but it has not yet been clearly distinguished from the known forms.

The PALÆOTHERIIDÆ embrace a greater number of forms, which fall into two well-distinguished divisions. In its complex premolar teeth, which in the upper jaw resemble the molars in composition, it shows an advance over the Chalicotheroid and other families of the Lower Eocene. In fact, it has not been found in the Lower Eocene, but commences in the Upper Eocene

PLATE XXXIV.

Views of skulls of species of Symborodon, one-sixth natural size. Fig. 1, *S. altirostris*; Fig. 2, 3, *S. acer*. From Ann. Report U. S. Geol. Surv. Terrs., 1873.

in the genera Palæotherium and Paloplotherium. Thence it extends to the very summit of the Miocene, and may even occur in the European Pliocene (Protohippus). Its members exhibit considerable range of variation in the details of the teeth and feet, but no striking break of family importance occurs. The most noteworthy interruption is that which is found between the Palæotherinæ and Hippotheriinæ, where there is a change in the form of the proximal extremity of the humerus from a tapiroid to a horse-like form, and a modification of similar significance in the molar teeth, by the addition of a deposit of cementum.

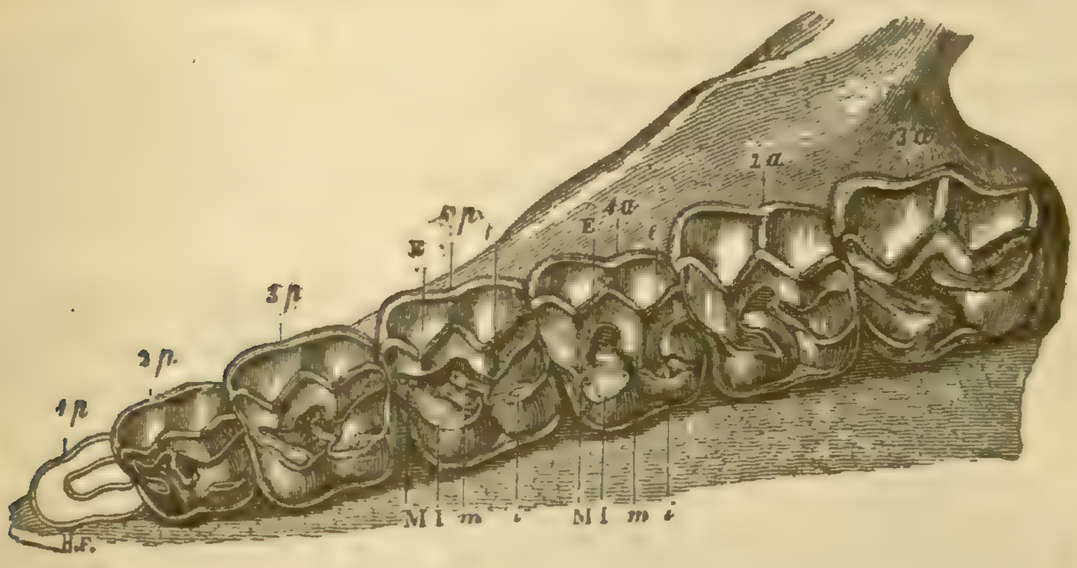


FIG. 32. *Palæotherium crassum* Cuv., superior molars from below, three-quarters natural size; from Gaudry. From the Upper Eocene of Paris.

The characters of the genera are as follows:

I. *Palæotheriinæ.* Bicipital groove of humerus simple; teeth without cementum.

a. One or more internal tubercles of superior molars distinct.

External V's of superior molars not well distinguished externally; ..... *Anchilophus.*

External V's separated by a vertical rib; intermediate tubercles not connecting fore and aft; ..... *Paloplotherium.*

External V's separated, intermediate tubercles extended fore and aft; ..... *Anchippus.*

aa. Internal tubercles of superior true molars continuous with the transverse ridges.

Inferior molars with two V's only; lateral toes large; ..... *Palæotherium.*

Inferior molars with distinct internal tubercles; incisors not cupped; ..... *Mesohippus.*

Inferior molars with cusps at the inner extremities of the V's; incisors cupped; ..... *Anchitherium.*

II. *Hippotheriinæ.* Bicipital groove of humerus double; molars with cement in the valleys. (Intermediate tubercles connected fore and aft; incisors cupped.)

a. One or more internal tubercles of superior molars distinct.
Inner lobes of inferior molars enlarged;.....*Hippotherium.*

aa. Internal tubercles of molars not distinct.
Inner lobes of inferior molars enlarged;.....*Protohippus.*

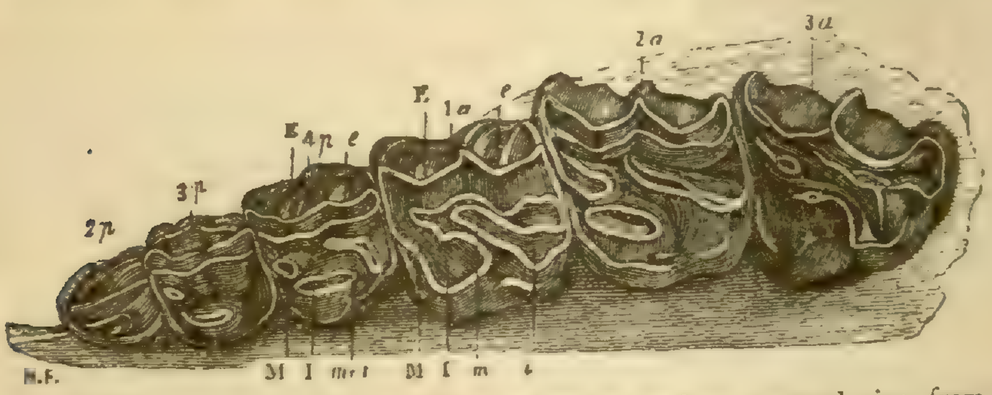


FIG. 33. *Paloplotherium minus* Cuv., superior molars, natural size, from below; from Gaudry. From the Upper Eocene of Lebruge.

Five genera of this family are European, and five are American. The Eocene genera are European only. Paloplotherium is found in the Middle Eocene, and is, as might have been anticipated, more nearly allied to the Chalicotheriidæ than any other genus of this family. Chalicotherium is not far removed from it. Anchilophus is Upper Eocene, and is allied to the genus just named, and also to Pachynolophus among the Chalicotheriidæ. These early genera constitute, by their similarity, the bond of connection between the three families, which, in their later and specialized forms, are very different from each other. Palæotherium is chiefly found in the Upper Eocene, and Mesohippus is only known from the White River or Oligocene, an age between Eocene and Miocene. Anchitherium commences in the Middle Miocene, and has Anchippus for a contemporary. In North America it remained, as late as the Ticholeptus epoch, in the *A. ultimum* Cope. Hippotherium existed only in the latter part of the Miocene epoch, consistently with the greatly specialized structure of its limbs and teeth. The nearly allied Protohippus lived with it, and in Europe a species with the same type of molar teeth is found in the Pliocene epoch (Forsyth-Major). These forms were

FIG. 34. *Palæotherium medium* Cuv., anterior foot, one-third natural size; from Gaudry. From the Upper Eocene of Paris.

contemporary with the Equidæ, which outlived them. They have many points of resemblance to that family, but, nevertheless, remain at a considerable interval from them in the structure of the feet.

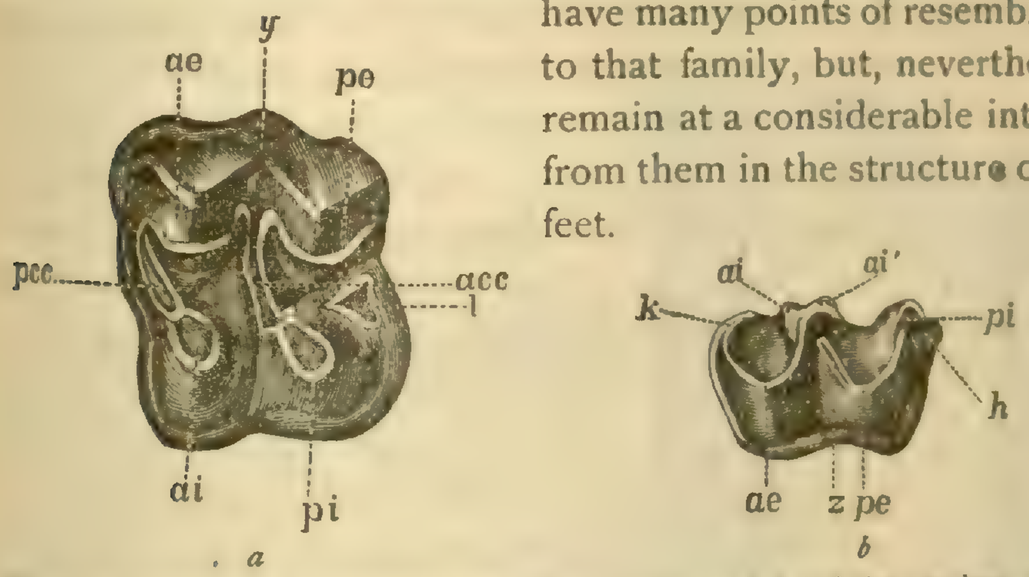


FIG. 35. *Anchitherium aurelianense; a*, superior, and *b*, inferior, molars, natural size; from the Miocene of France; from Gaudry, "Enchainements." Letters, *ae*, anterior external; *pe*, posterior external; *ai*, anterior internal; *pi*, posterior internal, cusps; *pcc*, anterior intermediate; *acc*, median intermediate; *l*, posterior intermediate; *acc*, posterior intermediate, cusps; *k*, *h*, and *z*, oblique crests.

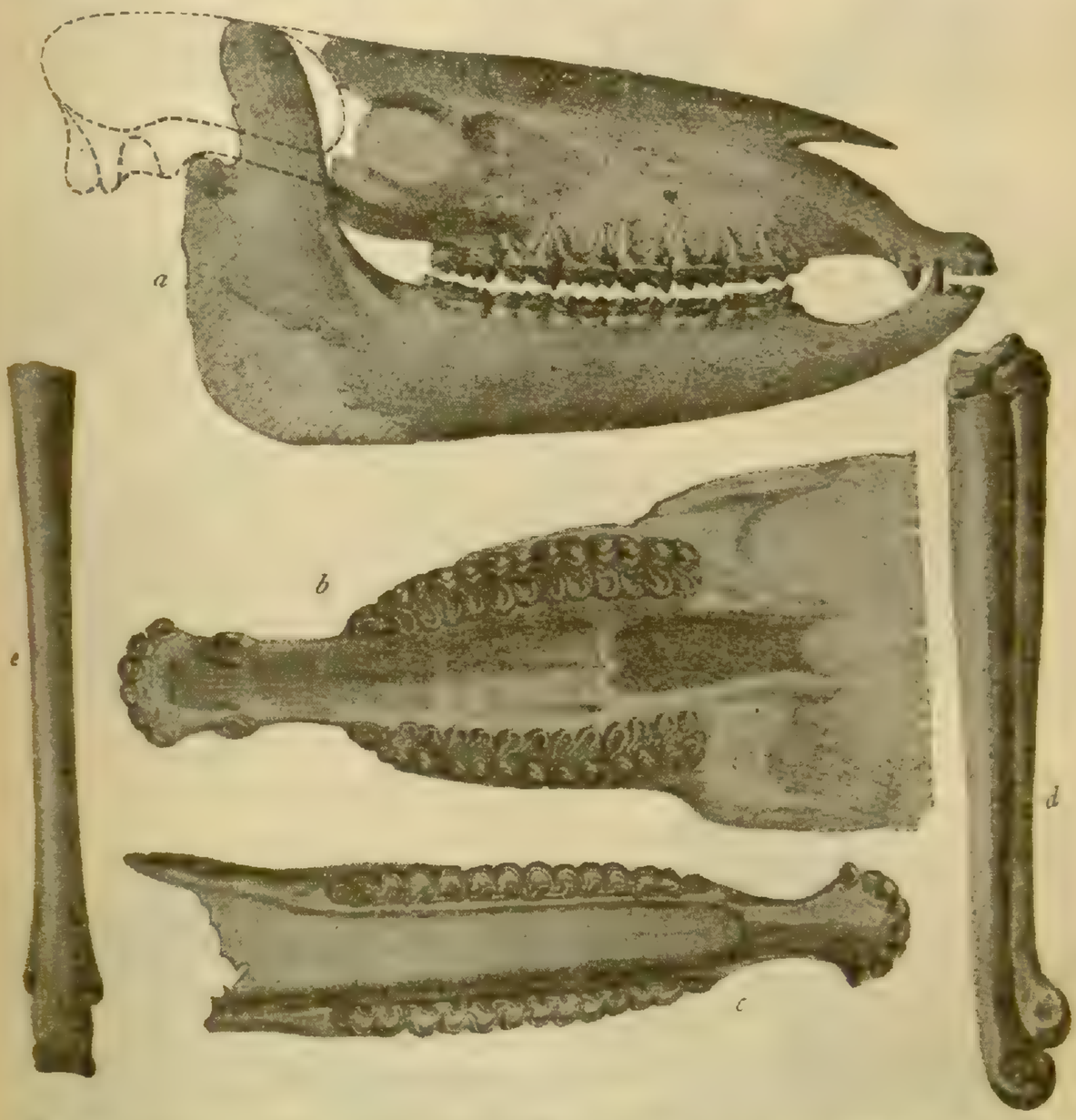


FIG. 36. *Anchitherium præstans* Cope, a little less than one-third natural size. Original; from the John Day (Middle) Miocene of Oregon. Fig. *a*, part of skull, right side; *b*, ditto from below; *c*, lower jaw from above; *d*, metapodial and part of tarsal bones from the inner side; *e*, the metapodials from front.

The phylogeny of the genera of this family is clearly, then, as follows: The genera with distinct internal tubercles must be regarded as primitive (Sect. I, *a*), and those with completed crests (I, *aa*) are derivative forms. The Hippotheriinæ are still later descendants on various accounts. First, the development of the intermediate tubercles is much greater than in any other genera. These tubercles are somewhat enlarged in Anchitherium (see Fig. 35, the anterior one), and they extend much further anteroposteriorly in Anchippus. In the Hippotheriinæ they reach and join each other at the middle of the crown (Fig. 40). In this transition the relations of the internal tubercles are various; for in Hippotherium, one of them (the anterior), remains distinct, while in Protohippus (Fig. 39) both are confluent with the intermediates. It may be

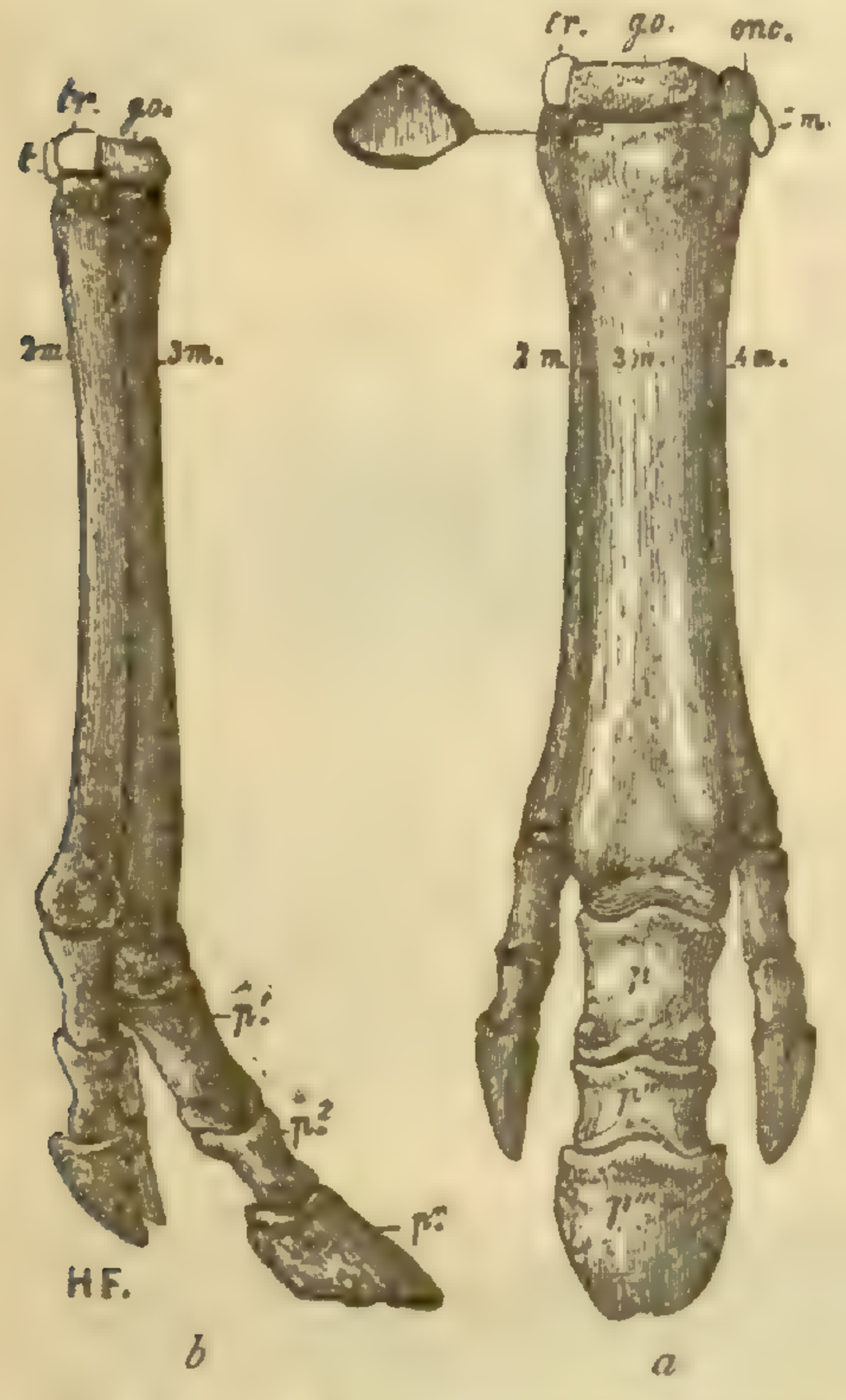


FIG. 37. *Anchitherium aurelianense*, anterior foot, less first carpal row, one-fifth natural size; from Gaudry. From the Miocene of Sansan, France. Fig. *a*, from front; *b*, from right side.

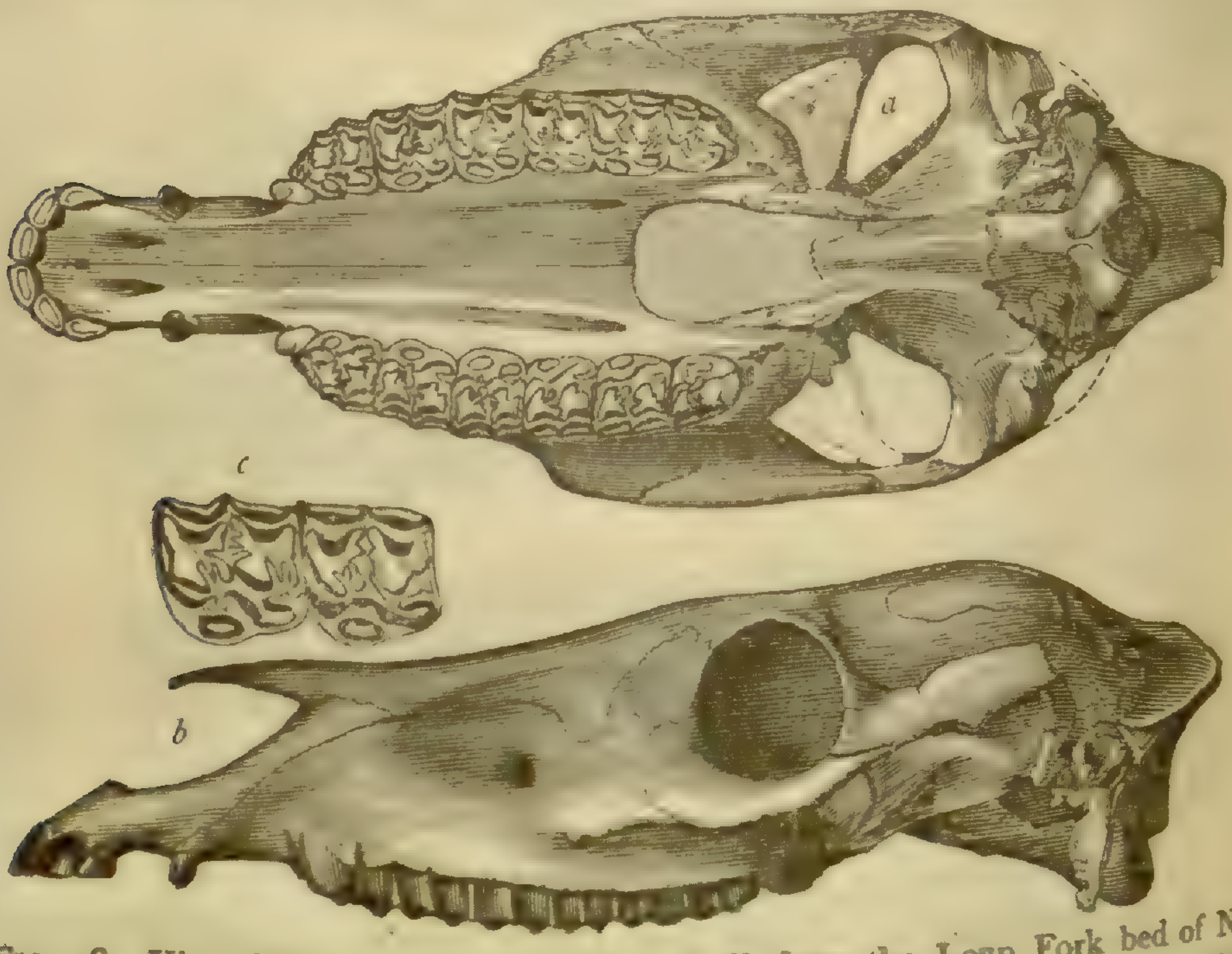


FIG. 38. *Hippotherium speciosum* Leidy, skull, from the Loup Fork bed of Nebraska, one-third natural size. Original. Fig. *a*, from below; *b*, left side; *c*, two superior molar teeth from below.

inferred from this that Hippotherium is a descendant of some genus of Sect. I, *a*, while Protohippus came from a genus of Sect. I, *aa*. The second point of modification to be observed in the Hippotheriinæ is the enlargement of the expansions of the internal extremities of the adjacent horns of the crescents of the inferior molars, which is

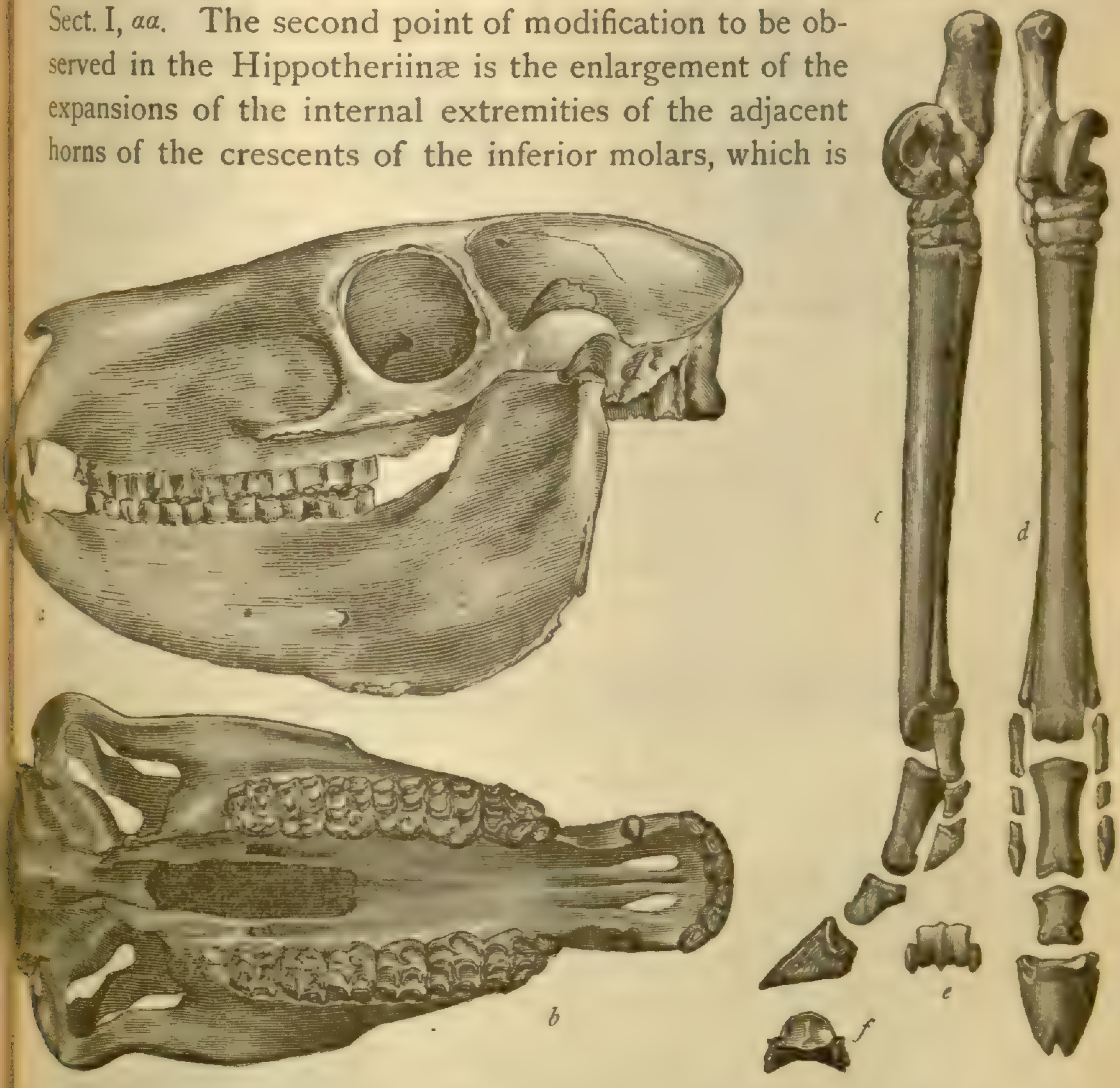


FIG. 39. *Protohippus sejunctus* Cope, one-third natural size. Original; from the Loup Fork Miocene of Colorado. Fig. *a*, skull, left side; *b*, ditto from below; *c*, posterior foot, left side; *d*, ditto, front; *e*, distal end of metapodials; *f*, proximal end of ungual phalange or hoof.

most obvious on wearing, and which are foreshadowed in Anchitherium (Fig. 35, *b*, *ai*, *ai'*). The third evidence of progress is seen in the deposit of cement, which fills the valleys of the teeth. Fourth, the two bicipital grooves of the humerus, which are identical with those seen in the Equidæ. Fifth, the cupping of the crowns of the incisors. This only commences with the genus Anchitherium, the otherwise nearly allied Mesohippus agreeing with Palæotherium and the genera of Sect. I, *a*, in the absence of the cup, as has been shown by Scott.

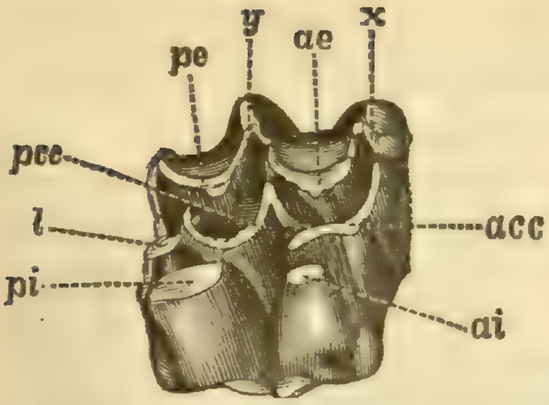


FIG. 40. Superior molar of Hippotherium from which the cementum has been removed, displaying the forms of the crests. From Kowalevsky.

FIG. 41. *Hippidium spectans* Cope, teeth. Original; from Pliocene formation of Oregon. Fig. *a*, superior molar from below; *b*, incisor surface of crown, showing cup. Natural size.

These relations may be expressed as follows, in tabular form:

Hippotherium.	Protohippus.
Anchippus.	Anchitherium.
Paloplotherium.	Mesohippus.
Anchilophus.	Palæotherium.

*
Type with internal cusps and with fewer premolars like true molars.

FIG. 42. *Equus crenidens* Cope, superior molar, pattern of enamel-ridges of crown. Original; from Pliocene epoch of Texas. Natural size.

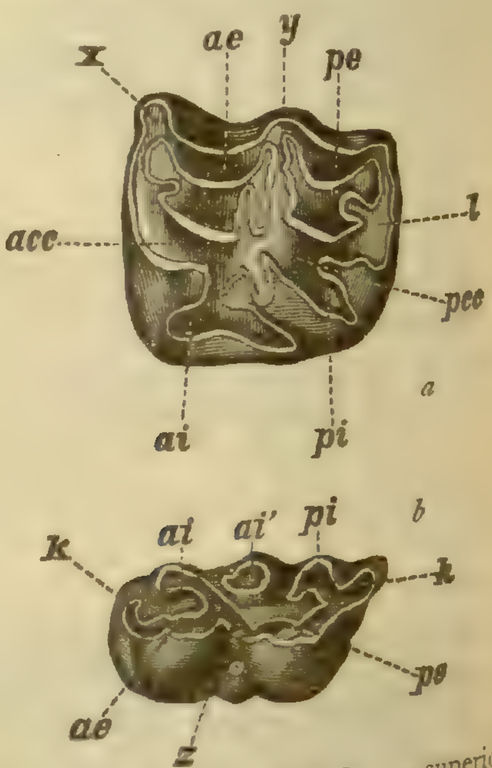


FIG. 43. *Equus caballus* L. *a*, superior, *b*, inferior, true molars. From Gaudry. Five-sixths natural size. Lettering as in Fig. 35.

The genera of EQUIDÆ are but two in number, and they are defined as follows:

Internal lobes of superior molars sub-equal; .....*Hippidium.*
Anterior internal lobes of superior molars much larger than the posterior;.....*Equus.*

The genus Hippidium is extinct, and its species have been thus far found only in North and South America, in beds of Pliocene and upper Miocene age. Equus made its appearance during the former period, and is represented by several existing species.

The Equidæ adds another evidence of greater specialization than the Palæotheriidæ in the structure of its feet,—*i.e.*, the distal metapodial keels are completed forwards, as in most ruminants. The mechanical cause of this extension remained, until recently, a puzzle to me. I have endeavored to show that the development of the tongue at the extremity of the metapodials of the Diplarthra was due to the impacts of the terminal phalanges often repeated, on hard ground, together with the compression of the surface on each side the keel by the flexor tendons with their sesamoid bones. But this did not account for the presence of the keel on the anterior face of the extremity. The instantaneous photographs of animals in motion by Muybridge have rendered the explanation easy. He shows that in Diplarthrous ungulates the phalanges are flexed at right angles *anteriorly* on the metapodials, at the last moment of rest on the ground before raising the foot for a new step. This movement is so quickly performed as not to be visible to the ordinary observer. This fact accounts for the late appearance in geological time of its effect on the end of the metapodial bone. I must add here that the acuteness and narrowness of the keel is partly due to the movement of torsion conveyed throughout all the bones of the feet at the moment of arrest by the ground, as referred to in the opening pages of this paper.

I must here describe another effect of torsion of the limbs at the moment of impact of the ungues with the ground, which I omitted from the proper place at the beginning of this paper. The proximal extremities of the metapodial bones are in most mammals extended inwards from the inner towards the outer side of the foot, so as to abut on the carpal or tarsal corresponding to the digit next external to them. This is due to pressure through

the carpals and tarsals of the second row or the heads of the metapodials, which is by the torsion turned from within outwards. The pressure thus applied has gradually pressed the heads of the metapodials outwards in the manner described. This effect began earlier than diplarthrism,[1] as it is seen in the Condylarthra.

In the preceding discussion of the phylogeny of the Perissodactyla the descent of genera within families has been described, and also the descent of families in their entireties has been discussed. The attempt to carry the line of generic succession across the boundaries of families has not been generally made. The lack of knowledge of such intermediate genera is the cause of this omission. Were such genera known, the definitions of the families would be less precise than they are. This complete phylogeny has been attempted, however, in the case of the genus Equus by various authors. The first suggestion was made by Cuvier, and the first arrangement of genera in the phylogenetic line of the horses was by Kowalevsky. His series commenced with Anchitherium, and had the other members Hippotherium and Equus. To this series Huxley added Palæotherium. Later, Marsh added two definite terms to the series, Hyracotherium and Hippidium, giving to both, however, new names (Eohippus and Pliohippus), and proposed two other steps (Orohippus and Miohippus), which were not sufficiently characterized to be since recognizable. The present writer determined the identity of the above forms, and added the still more primitive genus Systemodon. He also discovered and defined the Condylarthra, some of which, (Phenacodontidæ), he announced as the ancestor of all Perissodactyla, horses included.[2] Dr. Wortman followed, pointing out the double descent of the genus Equus from the two lines of Palæotheriidæ, and indicating the relations of species

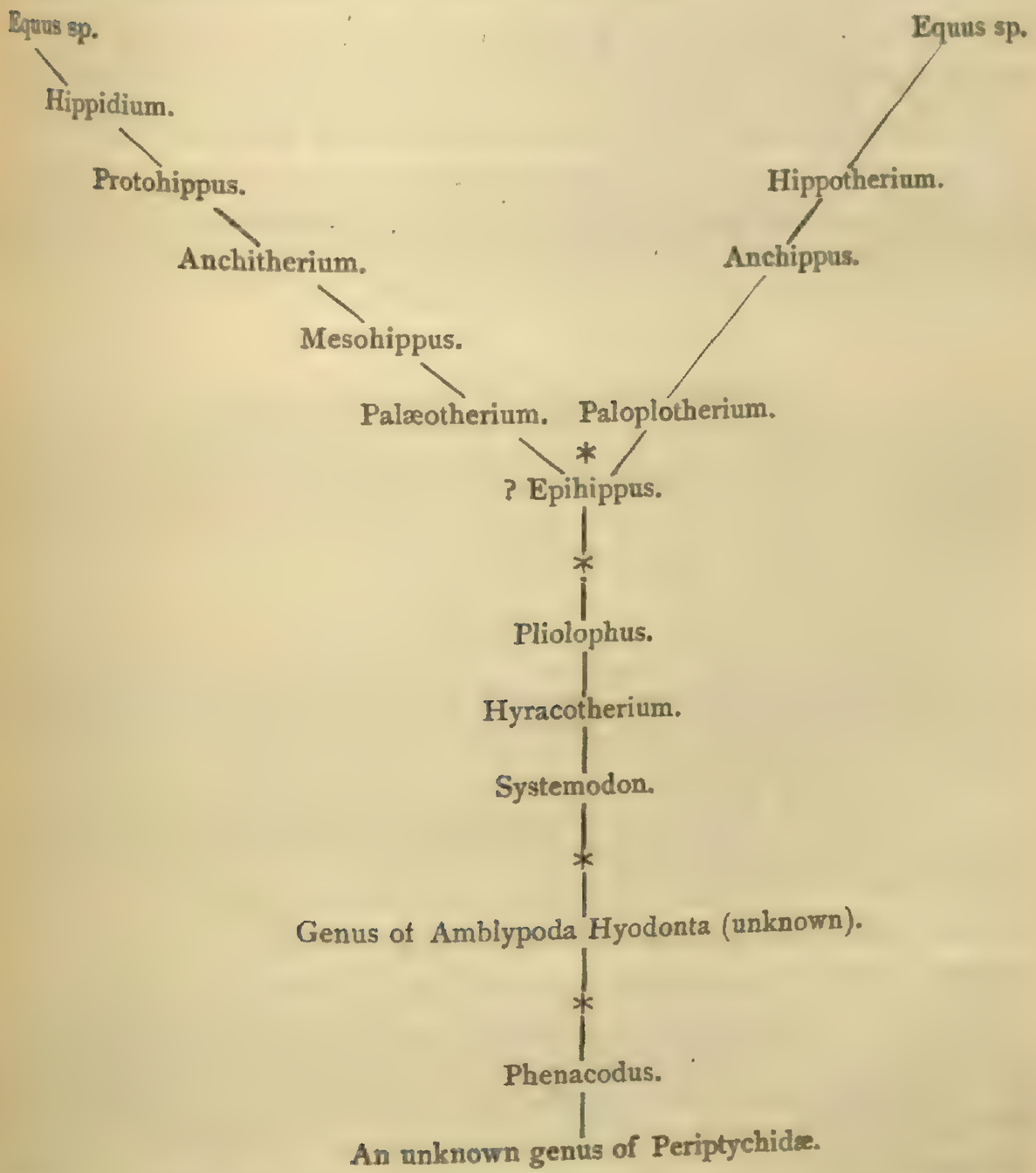
FIG. 44. *Equus caballus* L., manus, much reduced; from Gaudry, "Enchainements."

[1] Cuvier and Kowelevsky have shown that in the genera Sus and Dicotyles the head of the second metapodial is expanded inwards as well as outwards.

[2] Proceeds. Amer. Philosoph. Soc., 1881, p. 178.

of Equus to those of Hippotheriinæ.[1] Subsequently Scott pointed out the relation which the genus Mesohippus (Marsh) bears to the series. Schlosser followed,[2] throwing the Chalicotheriid and Menodontid genera out of the line into which they had been brought by Cope. In the present work the only change the author has made in his views is to return to his inclusion of the Menodontidæ in the line.[3]

As a result the following genealogy of the species of horse may be regarded as resting on the best evidence now available, as regards genera. It will be long before the line of species which has propagated itself to the present day, and appears in the *Equus caballus*, will be discovered.



[1] Revue Scientifique, 1883, p. 705. [2] Morphologisches Jahrbuch, xii., 1886, p. 31.
[3] Amer. Philos. Soc. Proceedings, 1881, p. 380; American Naturalist, 1886, p. 720.

It is certain, if the observation recorded by Mr. G. K. Gilbert is correct, that man was contemporary with species of Equus on the North American continent. I have identified[1] the remains of *Equus occidentalis* Leidy and *Equus excelsus* Leidy from the Upper Pliocene bed of Oregon, where they were mingled with obsidian arrow-heads and scrapers in a sandy bed easily disturbed by the wind. The contemporaneity of these remains being, under such circumstances, uncertain, it remained to discover them in a more solid deposit to confirm the suspicions raised by their association as first observed. Such a discovery is recorded by Dr. Gilbert as having been made in Nevada by a member of the United States Geological Survey. The *Equus occidentalis* thus shown to have been a contemporary of man, is not very close in characters to the true horse, but was proportioned more as in the ass. The head was as large as that of the horse, but the legs were more slender and a little shorter. It ranged from Oregon to Southwestern Texas, but its remains have not yet been found in the Valley of Mexico.

HORNLESS RUMINANTS.

BY R. C. AULD, F.Z.S.

(Continued from page 902.)

England, Wales, and Ireland.

IN treating of British cattle it is of interest to trace their origin. It may therefore be advantageous to quote the views of Prof. Boyd-Dawkins, especially as he has given the subject particular attention, and as I have had some correspondence with him in regard to polled cattle.

"The two principal stocks from which all the breeds are descended are undoubtedly (1) the Urus, an animal wild in the forests of Europe later than the days of Charles the Great, and which, so far as I know, was extinct in the British Isles before the historic period; and (2) the *Bos longifrons*, or 'small Celtic Short-horn,' an animal which never was aboriginally wild in Europe. Both were probably domesticated in Asia, and both make their appearance together in the Neolithic Age, in the

[1] Bulletin U. S. Geol. Survey, 1878, p. 389.

possession of farmers who lived on the wooden platforms and artificial islands in the Swiss lakes.

"The remains of the latter are to be found all over Europe in refuse-heaps belonging to various periods, from the Neolithic Age down to well within the historical frontier. It is the only domestic ox which I have met with in the large number of refuse-heaps in the British Isles, ranging from the Neolithic Age down to the time of the English invasion, and is represented by the present Highland cattle, small Welsh, and small Irish cattle.

"The first, or the Urus stock, preserved to us almost in its aboriginal purity in the so-called wild cattle of Chillingham, I am unable to trace farther back than the invasion of Britain by the English, and of Ireland by the Scandinavians. As the evidence stands, it was unknown in these islands as a domesticated animal before this time.

"The present breeds are, in my opinion, descended from the two stocks, and are the result of crossing and selection. The polled cattle I consider to be the result of selection, in which advantage has been taken of a tendency to revert to an ancestral hornless type, probably as far back as the Miocene Age. I should expect to meet with them from time to time in every breed, just as from time to time a horse is born with three toes, which have been derived from his remote Miocene ancestor, the Anchitherium."

He then refers to the case of the "breeding out of the horns in the Galloways" and the Gisburne polled cattle, on both of which points his observations are given in their proper place. The subject, however, of tracing the ancestry of all of the numerous British breeds, he says, he has as yet been unable to find time to deal with.

As supporting the view of the existence of the hornless character in the aboriginal races of cattle in Britain, there may be noted that certain foreign authors seem to have had evidence to that effect. Dr. Brocchi, in a most comprehensive and practical work,[1]—dealing first with *mammals*, in which come the various breeds of horses, cattle, sheep, and pigs common to France, or which have been introduced from other countries, with a description of their qualities and origin,—speaking of the *race Britannique*, remarks that the absence of horns characterizes this species of cattle. However true this may have been at one time, it is, as a

[1] "Traite de Zoologie Agricole, comprenant des elements de Pisiculture, d'Apiculture de Sericiculture, d'Ostreiculture, &c." Par P. Brocchi. Paris: Libraire, J. B. Baillière et Fils.

critic has remarked, "hardly correct, as a matter of fact, and is peculiar, to say the least," to-day. But if there had been a few more Marshalls among the breeders of Britain, it would, I believe, have been very true now.

Marshall, the celebrated authority, thus wrote (1780):

"There are already in this island three or four distinct breeds of hornless cattle; or rather, breeds of cattle many individuals of which are hornless. . . . These breeds are the old short-horned breed of Yorkshire; the Suffolk breed; a breed in Nottinghamshire propagated chiefly by the late Sir Charles Sedley, probably a variety of the Yorkshire breed [or of the White Park breed,—a herd of which is in this county]; and the breeds of Scotland, all of which, I believe, produce occasionally hornless individuals.

"The Galloways send out a breed almost wholly without horns, and some of them of good quality. Some of the Galloway cattle are not deficient in flesh. That of Nottingham has not come sufficiently under my notice to speak of its quality. For strong and middle-soiled districts there are individuals of the Yorkshire breed nearly perfect, especially for the purpose of milk and draft; as grazing stock the quality of the flesh may require some improvement. That of the Suffolk breed is well known to be of good quality. For lighter lands there may be superior individuals of the Suffolk breed in their present state sufficiently perfect for a basis at least. This breed has lately been used as beasts of draft in Norfolk with singularly good effect.

"I have digested my ideas, and I am clearly of opinion that . . . a breed of cattle answering nearly, if not exactly, the foregoing description will, in the nature of human affairs, become prevalent, if not common, to the Kingdom."

A prophecy that is likely eventually to become true, not only in Britain but in America.

Youatt divided the breeds of cattle of Great Britain, according to the comparative size of the horns, into five classes: (1) the *long-horns*, of the midland counties; (2) the *short-horns*, of the northern counties; (3) the *middle-horns*, of Devon, Sussex, Hereford, etc.; (4) the *crumpled-horns*, of Alderney and the southern coasts; (5) the *hornless*, or *polled*, of England and Scotland.

Polled Cattle among the Horned Breeds.—Any one must have observed that what Martin says is true,—

"Besides the polled cattle we have here noticed, varieties destitute of horns occur which confessedly belong to a horned race, and must not be considered as distinct. [He then notes the

Devon *natts* and Yorkshire polls.] The fact is, as we have before estimated, there are polled cattle of most breeds; the absence of horns is a mere accidental defect, rendered hereditary by the interbreeding of the cattle thus deficient; but these cattle, nevertheless, often exhibit a tendency to the development of their natural horns, and, indeed, show more than rudiments of them, so that it would be easy to extract a horned from a polled stock. Hence, then, we regard the distinction between polled cattle and others as arbitrary, or to be made only for convenience, unless there are other grounds of separation."

The Yorkshire Polls.—It is of importance to find that there exists a breed of polled cattle in Yorkshire described by all the early writers. Marshall, in his "Rural Economy," says,—

"In the North Riding of Yorkshire, at the commencement of the eighteenth century, the ancient black cattle were the only breed in the district. They resembled the present breed of the Lowlands of Scotland, mostly horned, but some of them humbled." (This is his "class 2," noted later on.)

Culley's supposition that they must have descended from the Galloway is untenable in the face of the existence of a county breed of polled cattle of much greater antiquity than the Galloway itself. I am supported here by the highest authority in Britain, among others, Mr. James Sinclair, editor of the *Live Stock Journal*.

What Culley says of the Yorkshire polls is as follows:[1]

"The polled or humbled cattle come next under our consideration, a kind well deserving of notice. We find a few of these straggling through different parts of England and Scotland. Among the rest, I remember Lord Darlington, not many years ago, had a very handsome breed of them finely globed with red and white."

Richard Parkinson[2] says,—

"Yorkshire polled cattle vary from the short-horned, already described, only in being without horns, which is a loss of about ten shillings a beast, as will be explained hereafter more fully. These cattle are generally handsome, and as good for the pail. There is a very conspicuous mark by which good breeds may be distinguished from bad,—namely, if the crown of the head be fine, like that of a doe, drawn almost to a point on the top, it indicates that the breed is good; this observation is worth notice in horned cattle. They require both richer food and greater age

[1] "Observations on Live Stock," by George Culley, 1786. [2] Live Stock.

than many other kinds to bring them to perfection, and are the most improper to breed on barren soils, badly sheltered, for such stinting would render them, in a very short space of time, small and coarse; and, as age is required, they suit best on situations a great distance from market, where part of the land is not good enough to fatten, but of a grazing quality, to keep stall stock in a growing, thriving state, and a portion sufficiently good to make them up for sale. Great numbers of these cattle bred in Yorkshire are fed on the fine rich marshes of Lincoln. But the best of them, both polled and horned, although of a good kind, are fattened at a more early age than their nature requires. Some of these large beasts are particularly fine on the crown of the head,—a point to which great regard ought to be paid in the choice of a bull, for several reasons. I have observed it to be a valuable symptom as to fattening; but from a general remark of the cow-keepers in London, a cow having the least appearance of a bull is a sure sign of her being a bad milker, therefore the finer the bull is on the forehead the more likely are his offspring to resemble him. Many cattle of these breeds have the worst hides,—so thin as to be deemed *paper hides*, which is a great fault. But it frequently happens that cows with these thin hides are only good for the pail: the best of them will give from thirty to thirty-six quarts of milk a day, from the time of calving till within three or four months of their calving again."

Parkinson has a good deal more to say under the above heading of "Yorkshire Polled Cattle," but he seems to fall away from those in particular to others in general. The crown of the head is twice referred to in the above. That *doe-headed* character is an interesting definition, as will appear: it might, *e.g.*, be easily contracted *doe 'ded.*

John Lawrence descants on them thus:

"The northern or Yorkshire polled cattle.—These have the same qualities as the short-horned cattle, carrying vast substance, and some I have seen lately are of great size, although in that particular they are most conveniently various. In my opinion they are a most excellent breed, and well merit improvement with the view of labor, by a selection of the finest breed and most active individuals. From the shape of these polled cattle, they hold a strict affinity in all respects with the short-horned, among which they are found, and it seems that various breeds of horned cattle are attended with hornless but perfectly congenial varieties. The above, for example, and the polled Galloways of Scotland, of similar shape and quality with the long-horns, also the Devon natts, a polled cattle on the coast."

Having already quoted from Froude, I may be allowed to make another extract, as evidence of the reputation of Yorkshire for breeding fine cattle having existed from a very early date. The following is quoted in his History, vol. v. p. 45, from a manuscript instruction to the English general commanding an expedition into Scotland. After saying that biscuit, wine, and horse provender were to be lodged at Berwick, the order goes on that two hundred and sixty-two carts were to be requisitioned; and adds, "which may well be purveyed in York, where the great oxen be, and the best wains."

From a highly interesting table of the results of trials conducted between the years 1833 and 1865, by the king of Würtemberg, as to the milking propensities of various breeds, the polled Yorkshire is included along with the Friesian, Swiss, Durham, and polled Norfolk, and is described as "Reddish brown and white." From this table, published 1883,[1] it now appears that the polled Yorkshire was a recognized breed for the dairy.

The Devon Natts.—Associated with the Devon breed there are the Devonshire natts. Young, in his last tour, noticed them in the neighborhood of Barnstaple. Lawrence describes them as middle-sized, thick-set, and apt to make fat.

Youatt says of them,—describing them along with the West Somerset sheeted cattle,—

"They do not exhibit the true Devon color in these uncovered parts, for the hair is yellow instead of a deep blood-red, or almost brown color. In North Devon few of the North Devons are to be seen, but they are the same party-colored kind of which I have just spoken."

The meaning of the word *natt*, or *nott*, will be given in the chapter on Philology, which will be found of considerable scientific value in tracing *the origin* of these polled breeds.

The Polled Somersets.—Professor Low, in his "Illustrations of British Domesticated Animals," published in 1842, gives an illustration of "The Sheeted Breed of Somersetshire," which shows,—

1. Cow, of the polled variety, the property of John Weir, Esq., West Carnell, Somersetshire.

2. One of the horned variety, four years old, from the stock of the late Sir John Philips, Montacute House.

[1] In National Live Stock Journal.

Low describes them as "a variety of cattle rendered remarkable by the striking contrast of colors on the body, found in Somersetshire and the adjoining counties. It has existed in some parts of England from time immemorial. The red color of the hair has a light yellow tinge, and the white color passes like a sheet over the body. The individuals are sometimes horned, but most frequently they are polled. The cows are hardy, docile, and well suited to the dairy. The beef of the oxen is of good quality and well marbled. The breed has become rare, which is to be regretted, since it is much better suited to the dairy than others that have been adopted. The peculiar marking which distinguishes these cattle is not confined to any one breed. It appears among the cattle of Wales, where they are crossed by the White Forest breed, and is frequently among those of Ireland, and used to be so among the older Galloways of Scotland."

Again, in his other work, Low, in referring to their peculiar marking, gives some additional particulars as to this:

"It is common in Holland, where the colors are black and white.[1] It may be ascribed to the intermixture of two races having each a tendency to produce the pristine color of the stock from which it is derived. Thus a mixture of the White Forest breed and a Devon might produce an animal resembling the sheeted Somerset, with the Black Falkland one resembling the sheeted varieties of the Dutch, and so on. The peculiarity, when communicated, is very constant, and when two animals possessing it are mixed together in blood the progeny never fails to preserve the markings of the parents."

The peculiarity of a white body on cattle was years ago not uncommon in Aberdeenshire. I have seen several. In all cases the white was confined to the body. In Aberdeenshire they are called—when a cow, for example—*a blanket cow* or *a plaidit cow*, —one having the plaid about her. The white in Galloways seems to have gone along the back, and, like the Irish cattle, in patches.

Derbyshire Polls.—Arthur Young ("General View of the Agriculture of Hertfordshire," published in 1804) gives some brief notes upon the variety of cattle of that county. He mentions finding Devon, Hereford, Welsh, Long-horned and Short horn cows in milk, and in one place, Hatfield, the Marchioness of Salisbury had all these, "and buffaloes both of the whole and of

[1] The Dutch Belted breed has been introduced into this country successfully.

the half-breed crossed with Scotch and Devon, for veal and beef of fine quality." Here, as generally throughout Herts, the Suffolk cows were regarded as the best milkers. He also states that "Lord Grimston has the Spotted Polled breed from Mr. Mundy, of Derbyshire, and approves of the sort greatly." These Derbyshire Spotted Polls may have been descendants of the white wild cattle of that district of which Mr. Storer[1] speaks.

Among Herefords and Short-horns.—Mr. William Housman, the well-known English authority on live-stock matters, has written:

"I know at the present moment, in a Hereford family, a registered pedigree and of high reputation in the show-yard, a heifer with only scurs, as the modified horns sometimes found in polled cattle, and in cross-bred offspring of polled and horned breeds, are called in Scotland. They are little bits of flat horn, loose at the roots, so that you can twist them about, and quite hidden in a mass of hair, continued from a thick, long tuft, which grows upon a pointed crown-ridge, and falls over the forehead and sides of the head; and I have seen similar 'scurs' and top-knots on several female short-horns. In the case of all the short-horns which had them, I was enabled to trace descent, in some cases many descents, from 'grandson of Bolingbroke,' who was also the grandson of a polled and Galloway cow. In the single case of the Hereford I cannot trace any alien blood; but the pedigree is not a long one. Unless we take for granted an inseparable correlation of sugar-loaf skull and tufted head with the lack of horns, we can scarcely suppose these cases to be original sports. The thick top-knot and the pointed ridge of the skull would seem to bear evidence of a polled ancestor, to whose peculiarities, in other particulars than the mere absence of horns, the animal reverts."[2]

Mr. A. B. Allen, of New York, the well-known authority, commenting on Mr. Housman's remarks, said,—

"I have seen an occasional superb specimen of what might be called a muley short-horn in Northumberland, England. . . . There are thousands upon thousands of polled cows already in the United States."

The late Charles Stevenson, who was a juror at the 1857 Paris International Exhibition, states that "one bull was exhibited in the aged short-horn class, color white, whose head was adorned with small round knobs, not exceeding two inches in diameter.

[1] Wild White Cattle of Great Britain.

[2] National Live Stock Journal, October, 1882.

We have occasionally seen females of the short-horn breed with horns descending by the side of the head, and apparently not very firmly attached to the skull."

These facts should encourage short-horn breeders in their desire to raise an improved breed of *polled* short-horns.

Shakespeare was acquainted with the polled cattle. One would not have expected Shakespeare to have noted the polled character, nor in the manner he does; but the lover of sport in the forest supplies us with the following:

"*Beat.* Too curst is more than curst; I shall lessen God's sending that way, for it is said, God sends a curst cow short horns: but a cow too curst he sends none.

"*Leon.* So, by being too curst, God will send you no horns."[1]

This is rather a different attributive explanation than has generally been given.

Shelley is also another "famous writer" who seems to have been acquainted with hornless cattle; and later, Mr. Rider Haggard is acquainted with hornless oxen and goats.

In Wales.—Pennant[2] says,—

"Our native kind [of cattle], such as the Welsh and Scottish, are small and often hornless."

Wirt Sikes, a United States consul in Britain, gives a Welsh fairy legend,[3] in which there is evidently a reference to polled cattle:

"According to a legend current in Carmarthenshire, there was in days gone by a band of elfin ladies who used to haunt a lake in the neighborhood of Aberdovey. They usually appeared at dusk, clad in green, accompanied by their milk-white hounds and their droves of beautiful white kine. One day an old farmer had the good luck to catch one of these mystic cows, which had fallen in love with the cattle of his herd. From that day the farmer's fortune was made. Such calves, such milk, such butter and cheese as came from the milk-white cow had never been seen in Wales before. The farmer, therefore, soon became rich, and the owner of vast herds. One day, however, he took it into his head that the elfin cow was getting old, and that he had better fatten her for market. On the day appointed for its slaughter people came from all sides to see this wonderful animal; but as the butcher's bludgeon was severing its head a fearful shriek re-

[1] Much Ado About Nothing.—Act II., Scene 1.

[2] History of Quadrupeds.

[3] British Goblins.

sounded through the air, and the astonished assemblage beheld a green lady crying with a loud voice,—

> 'Come, yellow anvil, stray horns,
> Speckled one of the lake,
> And of the *hornless* Dodin,
> Arise, come home.'

Whereupon not only did the elfin cow arise and go home, but all her progeny went with her, disappearing in the air over the hill-tops. Only one cow remained of all the farmer's herds, and, lo! she had turned from milky-white to raven-black. The farmer, in a fit of despair, drowned himself, and the black cow became the progenitor of the existing race of Welsh black cattle."

In Ireland—the Bogs.—Sir W. R. Wilde, M.D., has given some valuable details of the breeds of cattle of Ireland. He read a paper in 1858, published (1862) in vol. vii. of the "Proceedings of the Royal Irish Academy," entitled "On the Ancient and Modern Races of Oxen in Ireland." From it I quote as much as may be of interest:

"The animal-remains discovered in the great crannoge of Lagore, near Dunshaughin, county of Meath,—the first of the caverns or lake-fortresses which have been discovered during the last twenty years. The range of date of that crannoge has been fixed from A.D. 843 to 933. From these localities, as well as in deep cuttings made for the same purpose, and in peat-bogs, etc., other specimens of bovine remains have been deposited in the museum. I have selected twenty heads of ancient oxen, and arranged them in four rows, each row characteristic of a peculiar race or breed,—viz., the straight-horned, the curved- or middle-horned, the short-horned, and the hornless or maol, all of which existed in Ireland in the early period to which I have already alluded.

"According to my own observations, we possessed four native breeds about twenty-five years ago. First, the old Irish cow, of small stature, long in the back, and with moderate-sized, wide-spreading, slightly elevated, and projecting horns; they could scarcely be called long-horned, and they certainly were not short-horned. Their color was principally black and red. . . . Second, the Kerry, which is somewhat more of a middle-horn. Color, red, black, or brindled. . . . Third, the Irish long-horned, similar to, but not identical with, the Lancashire or Craven. . . . The fourth is the Maol or Moyle, the polled or hornless breed, similar to the Angus of the neighboring kingdom; called Myleen in Connaught, Mael in Munster, and Mwool in Ulster. In size they were inferior to the foregoing, although larger than the

Kerry, or even the old crook-horned Irish, but were comparatively few in numbers. In color they were either dun, black, or white, but very rarely mottled. They were not bad milkers, were remarkably docile, and were consequently much used for draught and ploughing."

Describing each set of skulls corresponding to the above, of the polled Sir W. R. Wilde says,—

"The last is the Maol, or hornless, which differs so little from its living representative of the present day that it is unnecessary to describe it. From the five specimens placed before the academy, it is evident that it was much smaller than the modern breed. One head differs from another only in the amount of the occipital projection. The average length of the face is about seventeen inches, and eight inches across the orbits."

In a paper in the same volume, "Upon the Unmanufactured Animal Remains belonging to the Academy," Sir W. R. Wilde gives "a list of fifty-two ox-crania now in the museum."

"Nos. 48 to 55 are eight hornless, or maohl, varieties, and all except the two first present a very remarkable protuberance, a frontal crest, but this is especially marked in Nos. 50 and 53. As the maohl ox would appear to have abounded in Ireland more than in any other part of Europe, I subjoin the accompanying illustration of this hornless variety, which may be taken as affording a good idea of its general characters. It was accidentally omitted in my communication upon the 'Ancient and Modern Races of Oxen in Ireland.'" (Fig. 19.)

FIG. 19.

Proceedings of Royal Irish Academy. Fig. 14, page 211.

I am tempted to add the following, from Sir W. R. Wilde's first paper, referring to the state of the best breed in Ireland in olden times:

"The relics of our ancient oxen are not only abundant and interesting to naturalists, but are exceedingly curious in an historical point of view, as they afford undeniable evidence that, so far back as the eighth or tenth century at the latest, we had in Ireland a breed of cattle which, for beauty of head and shortness of horn, might

vie with some of the best modern improved races so much admired by stock-masters, and which are now being reintroduced from England."

Low and Youatt have long notes on this Irish breed:

"It is a variety scarcely known to the breeders of England, but which, from its properties, deserved far more attention on the part of the community where it has been naturalized. It has existed in Ireland from an unknown period, and appears to have been once widely diffused. It is now scattered throughout the country, and is only found in some numbers in the Vale of Shannon. They were of a light brownish color. They are superior in size to the Suffolk Duns, and equalling in this respect the larger class of short-horns. The breed has probably been formed by an early mixture of Dutch cattle with some of the native races. Had attention been directed to it at an early period, Ireland would have possessed a true dairy breed, not surpassed by any in the kingdom."

Of this ancient polled Irish breed the authors of the "History of Polled Aberdeen or Angus Cattle" quote from the *Irish Farmer's Gazette* in one of its August numbers, 1847:

"A relative of our own, deceased a few years ago at the age of one hundred and fourteen, had polled cattle in Ireland, and stated that the same breed had been in possession of his great-grandfather some two hundred years before our informant was born. These cattle were chiefly black, and black and white on the back; occasionally red, and brindled with white stripes; in some cases all white but the ears, which were red; and he believed there was never any intermixture of English or Scotch blood among them for the period he alluded to. They possessed the characters of being great milkers and good butter-producers."

Large importations of these Irish polled cattle arrived as late as 1750 at Port Patrick, in Scotland, and met a ready sale.

So late as 1826 these Irish polls seem to have existed. Andrew Henderson, son of one of the most extensive and spirited farmers of Dumfries-shire, thus writes of them ("The Practical Grazier," 1826):

"Several black or dark-colored ones are to be found, which, when brought to Dumfries market, are readily bought up by the Annandale jobbers, who soon convert them into Galloway cattle by mixing them with such lots and passing their word and honor as to the purity of the whole."

Youatt says the famous long-horns of England were derived from the Irish long-horns. What has become of all these famous Irish breeds? Mr. James Sinclair (already noted), in a recent paper on "Kerry Cattle," says that, "with the exception of the Kerry, all the native Irish races have become extinct, being crossed out by the short-horn." This is one great irretrievable loss, the cause of which has to be laid to the charge of the short-horn,—the loss of many of our finest old native breeds in various parts of Britain as well as Ireland.

Prof. P. McConnell, F.H.A.S., of Oxford University, also refers to these Irish polls or moylés in his "Agricultural Note Book," third edition, 1887.

Scotland.

In dealing with the polled cattle of Scotland I shall first give what Marshall and Lawrence have to say on the subject, and then detail the particular references to polled cattle discovered by original research, reserving some important points bearing on the wild white and the two black domesticated breeds for orderly treatment.

Mr. Marshall,[1] about the earliest general authority adducible, thus classifies the Scotch cattle driven from Scotland and fed in Norfolk in the end of the last century:

(1) Galloway Scots, mostly hornless, of a black or brindled color.

(2) Lowland Scots, some of them horned, some of them polled; their color black, or brindled, or dun.

(3) Highland cattle have in general, but not always, horns.

(4) Isle of Skys.

In the second class are included the breeds of a region—Caledonian—*three or four times larger* than the region of the Galloways. This it is important to remember, and it is most probable that a large proportion of the Scots sold in England as Galloway polled were really Angus and Aberdeenshire polled, for, as the writer on "Cattle of Great Britain" points out, it was simply on account of the propinquity of the district, thus being better known, that its polled cattle obtained in England the territorial term by which they became known, and hence also all Scotch polled cattle from whatever quarter, as they had to be driven

[1] Rural Economy of Norfolk, 1795, vol. i. p. 340.

over the same routes into England as the Galloways themselves.

The information of Marshall is derived from direct observation, hence it is of certain value.

John Lawrence thus treats of the subject:

"The Scottish Island, Mountain, and Lowland Cattle.—It is not improbable that there were only two original species of neat cattle in Scotland: those common to the islands and the mountain country, called kyloes; in color black, brindled, dun, brown, red; black being the favorite color in Scotland; in form flat and deep, like the short- and middle-horned stock, very small and hardy, with small, upright, short, or middle-length horns: and the polled breed, chiefly confined in latter times to the shire of Galloway, and known by that name. The former, the smallest and most hardy breed known in this island, and apparently the same with that of the more northern counties, may be seen at this day in its original purity, no motive existing for crossing a breed so perfectly adapted to severity of climate and scarcity of keep. The original polled cattle were of the same colors, but more varied, and considerably larger in size; in shape somewhat long, and resembling the long-horned species, with hides of considerable thickness; when these cattle are entirely hornless they may be presumed of the genuine breed. In the Lowlands, where the soil is abundant in provision, and where in consequence larger-sized cattle are supposed most advantageous, much crossing under the name of improvement has taken place. Thus the Scots polled cattle have been perpetually crossed with English bulls, both short- and long-horned, with Norman, and with their own mountain stock, whence the varieties of Galloway, Ayrshire, Fifeshire, and of the runts,[1] which are at this day found in Scotland." (Pp. 72, 73.)

The polled cattle of Scotland were known well enough apparently in France early in the century, for they had erroneous notions of them: "Même en Ecosse on trouve la race très petite, et fort souvent sans cornes."

I shall now detail various original evidences of the existence of polled cattle in Scotland, discovered in various unsuspected places.

"*Homyl*" *Cattle at the End of Eighth Century.*—Perhaps the earliest notice of the existence of polled cattle in Scotland to which a date can be assigned is that which may be found in Bellenden's "Hystory and Cronikles of Scotland." Buke x. c. 12, gives the "laws maid be Kenneth for the comonweil of

[1] See below: extract from "Hand-Book to Scotland."

Scottis." They refer principally to the domestic relation, and the twenty-first reads as follows:

"Quhen vncouth Ky fechtis amang thaym self, gif ane of thaym happenis to be slane, and vncertane quhat kow maid the slauchter, the kow that is homyll sall beir the wyte,' and the awnar thairoff sall recompens the dammage of the kow that is slane to his nychtbour."

"This," says a commentator on the passage, "certainly proceeds on the supposition that the animal slain exhibits no marks of having been gored."[a]

In Rev. Raphael Hollinshed's work the passage is thus rendered:

"If oxen or kine chance by running together to kill one another, the truth being not known which it was that did the hurt, that which is found without horns shall be judged the occasion of the skeath, and he that is owner of the same, shall have the dead beast, and satisfie him for the losse to whom it belonged."

The only comment to make is that the polled cattle of those days were credited with much vigor, and must have been very numerous.

Dr. Norman Macleod's Legend.—In the beautiful legend "The Spirit of Eld," given in his "Reminiscences of a Highland Parish," "three dun hornless cows" are prominently mentioned, and drawn in the accompanying illustration by Millais. This "dun" color was, according to Youatt, the usual color of the Highlanders' "fairy cattle." The mention of "hornless" in such legendary lore indicates a very early existence for polled cattle.

Polled Cattle on the Sculptured Stones of Meigle.—The age of these stones is given as dating from 900 A.D. to 1000 A.D., and may be seen in the old school-house of Meigle. The sculptured stone is figured in Plate LXXVII. of the Spalding Club's "Sculptured Stones of Scotland." The figures—as other representations of cattle in some of the same plates—are certainly meant for polled cattle.

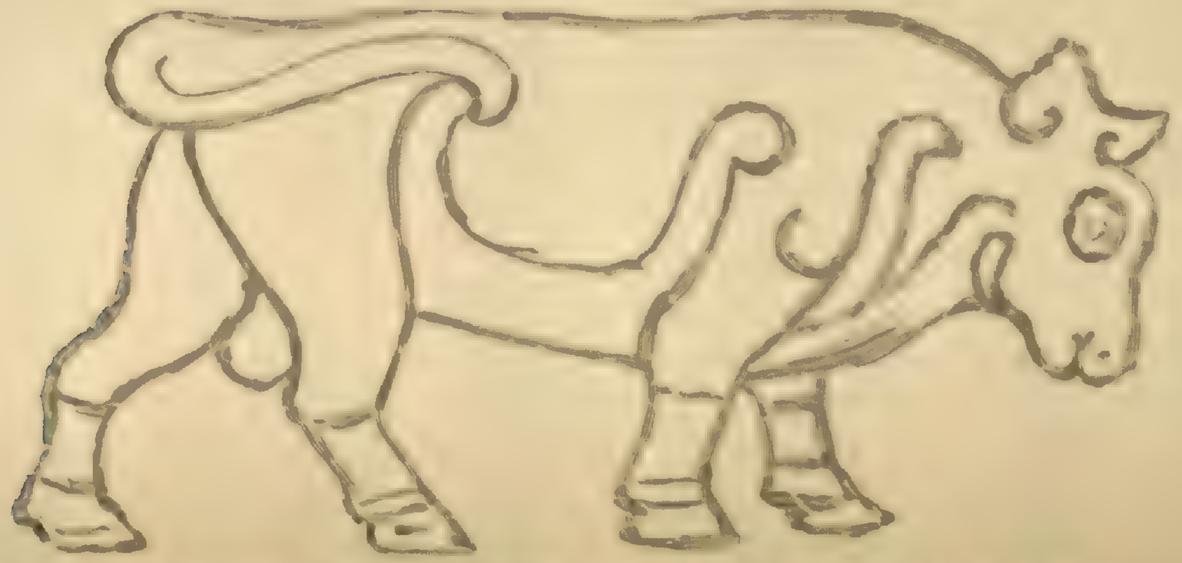
A correspondent, Mr William McCombie Smith, Persie, Blair-

[a] For an illustration of the meaning of this, see "The Breed that Beats the Record," by the author, p. 69. Albine Co., Detroit, Mich.

[b] Johnstone's Scottish Dictionary.

PLATE XXXV.

In minister's garden at Meigle. Plate 77. Spalding Club.



Spalding Club. Sculptured stones of Meigle at Inverness. No. 2, p. 38.

gowrie, walked "twelve miles in two and one-third hours" to examine these stones for me, and from the descriptions and impressions he made of them I am satisfied that they represent polled cattle. He reports that the natives regard the figures as representing polled cattle,—rather remarkable, as we might expect them to take the opposite view. This is strong testimony in their favor. The mention of homyl cattle about the same time, in the annals of Kenneth, who had his court not far from the same place, at this time, is also contributory evidence in their favor, and the sculptures may illustrate the combative tendency of the homylies of his time.

Evidence from a very Curious Source.—There is a most curious, quaint, and rare little book, preserved in the British Museum, entitled "A Modern Account of Scotland. Being an Exact Description of the Country, and a True Character of the People and the Manners. Written from thence by an English Gentleman. Printed in the year 1679." It is attributed to one T. Kirke. He gives an interesting peep into the state of the country at that time, but was strongly prejudiced against the people he visited. I quote the following passage from him:

"Their Cattle are only representatives of what are in other Countreys, these being so Epitomized that it is hard to know what class they relate to. Their Horses are hardy, and not without Gall (as some say other Horses are), using both tooth and nail to mischief you: that they may not use more state than their masters, they go Barefoot, which preserves them from the Gout; and if Hudibrasses Horse had been of this race, he had not needed a Corncutter. Their Furniture or Harness is all of the same matter, all Wood, from head to tail, Bridle, Saddle, Girths, Stirrups, and the Crupper, all wood; nothing but a Withy will bend a Witch, and if these be called Witches I shall not oppose it, since by their untoward Tricks one would guess the Devil to be in them; their Bridles have no Bits, but a kind of musroll of two pieces of wood; their Crupper is of a stick of a yards length, put cross their docks, both ends thereof being tied with woven wood to the saddle. Their Bed and Board too is all of the same dry Straw, and when they have it up, whip on Harness and away. Their neat are Hornless, the owners claiming sole propriety in these ornaments, nor should I deny them their Necklace too, for one thinks that twisted wood wou'd mightily become them. Their Sheep too have the same preferment, they are coupled together near their masters Palace. Some animals they have by the name of Hogs, but more like Porcupines bristled all over, and these are

likewise fastened to the Freehold by the former artifice; all their quadrupeds (Dogs alone excepted, in which sort they much abound) are honored with wooden Bracelets about their necks, legs, or arms, &c."

The first word cattle is here used in its original sense as given by the lexicographers. Todd says the term *chattail*, a provincial term, is used about Lyons, in France, for *all* the beasts of every kind on an estate. Johnson's definition of the word is "Beasts of pasture—not wild nor domestic." Richardson's definition is "Kine, horses, and some other animals appropriated to the use of man." Then we have the term *neat*. It is not accompanied by the word *cattle*, as it is in later forms, as *neat cattle*. It is used also in its original manner. It is the same as the English *nolt* and the Scottish *nowt*. The latter word, *nowt*, is still used in Scotland, by itself, to signify cattle, exactly as it is by T. Kirke. These facts are interesting, and are useful in explaining how afterwards kine and oxen had to be termed, generally, *horned cattle*, "to distinguish them from horses." This term horned cattle was used of beeves in England, whether they were long-horns, middle-horns, short-horns, or polled. But in Scotland, where cattle (neat) without horns had been as indigenous as cattle (horses) that never had such "preferment," the former were called "dodded," etc., "to distinguish them" from the latter.[1]

Sheep used also to be termed *small cattle*. While on this matter I may note here that I have seen the word *stot*, meaning a young ox, applied, in documents of the fourteenth century referring to certain Norfolk manors, to include horses. Among cattle-dealers of the present day the old term *beast* is used in the same sense as nowt in Scotland. The word *Beast* is the word still stereotyped on the bills of sale of the London salesmen to denominate cattle of the cow kind, and still pronounced *beece*.

I shall not venture further to explain the passage from T. Kirke, but along with the somewhat paradoxical case from Bellenden allow the reader to make his own construction. For us, however, the interesting fact remains that previous to 1679 A.D. the cattle of the Scots are stated by an observant traveller to have been hornless. Where had he seen them? or to what now existent race could the observation apply?

It certainly would not be in the south of Scotland that the

[1] Statistical Account of the Parish of Bendochy, 1795.

"English gentleman" wrote his account. It would be farther north. In a previous paragraph he writes:

"*Woods* they have none, that suits not with the frugality of the people, who are so far from propagating any that they destroy those they had upon this politic State maxim, That corn will not grow on the Land pastered about their humble conversation, that exceeds that of hornless Quadrupeds; marry, perhaps some of their Houses lurk under the shelter of a plump of Trees (the Bards not daring such a high presumption), like *Hugh Peter's Pass* in her Majesty or our own in an Ivy bush."

He was in the north, in a region where the "neat were hornless," where the country was bare of wood, etc. Where could so many marks of identity be found applying to any other district but *Buchan*, to which was applicable Dr. Johnson's (who passed through this region) not very correct remark of Scotland: "A tree might be a show there, as a horse in Venice," and which has been remarked by succeeding Sassanach visitors, as the "Druid," who wrote of the same district, that in 1820 "*Timberless* Buchan was great in 'doddies,'" meaning, possibly, to perpetrate a witticism on the character of the country and the cattle in it. At any rate, his observations would have been made in the Caledonian region.

The Dun Cow again.—In a book, "The Modern Husbandman," written by W. Ellis in 1750, is the following passage:

"I know a gentleman at this time that keeps the dun breed as a rarity for their particular color, small size, and their being polled, or without horns. These are of the Scotch kind, will live on a short bite, and milk better than some others of the same bigness. As they are hornless, they consequently will fat with lesser meat than the horned sort, and though the bull has little 'dub,' short horns (and the cows none), yet they are so small that it is out of his power to do mischief with them, and thereby the owner may depend on being free from the danger of being instrumental in shedding man's blood, which too many have brought themselves under by obstinately keeping a horned bull that they knew before to be unlucky."

In the North of Scotland.—Captain Burt, in his "Letters from the North of Scotland to his Friend in London," published 1754, vol. ii., letter xx., says,—

"I have several times seen them driving great numbers of Cattle along the sides of the Mountains at a great distance, but

never, except once, was near them. This was in a Time of Rain, by a wide River, where there was a Boat to ferry over the Drovers. The Cows were about fifty in Number, and took the Water like Spaniels; and when they were in, their Drivers made a hideous Cry to urge them forwards: this, they told me, they did to keep the Foremost of them from turning about; for, in that Case, the rest would do the like, and then they would be in Danger, especially the weakest of them, to be driven away and drowned by the Torrent. I thought it a very odd Sight to see so many Noses and Eyes just above Water, and nothing of them more to be seen, for they had no Horns, and upon the Land they appeared, in size and shape, like so many Lincolnshire Calves."

Noted by Pennant, 1769.—Pennant, in his tour, has noted the existence of polled cattle in Sutherlandshire, and, at an earlier date, noted that the Scotch cattle were "often hornless."

By Dr. Samuel Johnson and Boswell in 1773.—Dr. Samuel Johnson, in his tour in Scotland, passed through the Buchan district of Aberdeenshire, in 1773, on his way to the Highlands. When in Skye the doctor appears to have been particularly struck with the cattle and the manner of treating and marketing them:

"Of their black cattle, some are without horns, called by the Scots humble cows, as we call a bee a humble bee that wants a sting. Whether this difference be specific or accidental, though we inquired with great diligence, we could not be informed. We are not very sure that the bull is ever without horns, though we have been told that such bulls there are. What is produced by putting a horned and unhorned male and female together no man has ever tried that thought the result worthy of observation."

A worthy passage! As a sequel to it I quote a passage from the constant Boswell:

"This forenoon (November 4, 1773) he (Dr. J.) observed some cattle without horns, of which he seems to have taken notice in his journey, and seems undecided whether they be of a particular race. His doubts appear to have had no foundation, for my respectable neighbor, Mr. Fairlie, assures me they are a distinct species, and that when any calves have horns a mixture of breed can be traced. In confirmation of his opinion he pointed out to me the following passage in Tacitus ['De Mori et Pop. Germ. 5," (already quoted)], which he wondered had escaped Dr. Johnson."

It is impossible that in Skye the Scots called these hornless cattle *humble*. The only word they knew was *maol*. Hence the

doctor must have picked the word up from "the Scots" in other parts, as in Buchan, which he passed through.

References by Sir Walter Scott.—It is of great interest to note, as has already been done, what light our leading men of letters throw in their works on subjects of local investigation, when, especially, they held the traditions and antiquities in their minds so thoroughly. Luther, Shakespeare, and others had not allowed the natural character to escape their notice. By Burns this mention of polled cattle is conspicuous by its absence. This fact is the more remarkable, as he farmed for a time in Galloway. In one of the statistical accounts he is mentioned, not as being satisfied with Galloway cattle, but as introducing Ayrshires. It is passing strange that this natural character, which, as to proverb, lent itself so well to endearing use, should have not been utilized by him. We have failed to discover a reference by him. It is quite different with Scott. In "Old Mortality," chap. iv. (the date of the scene of which is about 1670), "the humle cow, the best in the byre of Niel Blaire," is recorded. This famous humle cow, note, had passed through several hands, and had been successively passed on to Niel through the hands of the drovers, she having come from the north. In "Guy Mannering," chap. ix., we find "Grizel chasing the humble cow out of the close." This scene opens with a description of Ellengowan, in Dumfries-shire, a conspicuous feature of which were "the green pastures, tenanted chiefly by herds of black cattle, then the staple commodity of the country," which cattle were (chap. ii.) "*Highland cattle.*"

In "The Two Drovers," chapter ii., is a colloquy between Mr. Ireby and a "Highland" drover, hailing from Doune:

"'And which peasts wad your honor pe for having?'—'Why—let me see—the two black—the dun one—yon doddy—him with the twisted horn—the brocket—How much by the head?'—'Ah,' said Robin, 'your honor is a shudge—a real shudge—I couldna have set off the pest six peasts better mysell, me that ken them as if they were my bairns, puir things,'" etc.

In the same chapter another drove is referred to by the same parties, together:

"'I passed another drove,' said the squire, 'with one of your countrymen behind them—they were something less beasts than

your drove, doddies most of them—a big man was with them—none of your kilts though, but a decent pair of breeches—D' ye know who he may be?'—'Hout aye—that might, could, and would be Hughie Morrison—I didna think he could hae peen sae weel up. He has made a day on us; but his Argyleshires will have wearied shanks. How far was he pehind?'" etc.[1]

In the same chapter is the following sentence:

"Ye ken, Highlander, and Lowlander, and Border men are a' ae man's bairns when you are over the Scots dyke."

How applicable is not the above to my contention as to the different Scotch breeds, on their crossing the Scots dyke? There was no distinction, all the horned Highlanders were Kyloes, and all the polled Lowlanders were Galloway, and Kyloes and Galloways were all Scots. Doune was in the centre of Caledonia, the region from whence class 2 of Mr. Marshall were drawn.

What influence was it that made doddies and humlies of so live an interest to Sir Walter? He was a personal friend and guest of Mr. Hugh Watson, Keillor, Forfarshire, the celebrated breeder of polled Angus cattle. It was undoubtedly from this association that Sir Walter got his knowledge of the polled cattle of his native country. Nowhere does he mention the term by which they became known—"Galloway"—in connection with cattle at all, though he uses this term in connection with the nags of that region; and no man was better acquainted with the border counties than he. He always uses the terms—to describe his polled cattle—by which were exclusively known the Angus and Buchan polls (*doddies* and *humlies*). From this it may be inferred that he knew that these descendants of the original polled cattle of Scotland were exclusively an appurtenance of the great Caledonian region.[2]

Rev. James Headrick, A.M. (first editor of the Highland So-

[1] To prove how early the cattle trade from the north to the south existed, I quote the following:

"In those days [about 1560 A.D.] a drover of the name of Rory, a wealthy man, and doing a large trade, was in the habit of lodging with Allancuaich [in Braemar] on his way to and from the south markets, after an unusually great sale and large profit at Amulrie." (Legends of the Braes of Mars. By John Grant, Glengairn.)

[2] See a paper by the author, "Origin of Scotch Breeds of Cattle," in Agricultural Gazette Almanac, 1887.

ciety's Transactions), author of the "Agricultural Survey of Angus-shire," published in 1813, writing twelve years later, said,—

"The polled are not confined to Galloway. I have frequently seen individuals without horns among the cattle in various parts of the Highlands and isles."

This is very important evidence. But, further, and even more interesting, William Aiton, author of the "General View of the County of Ayr," dated 1811, writes (p. 412), referring to the horns of the various breeds of cattle, "the breed of Mull have none."

John Smith, D.D., in his "Survey of Argyleshire," says of the cattle, "Few of them are polled;" which indicates that polled ones did, however, occur.

Obliteration of a Modern Polled Race—Fife Polls.—Youatt, p. 117, says,—

"A breed of polled cattle has also made its appearance in Fife, possessing all the good qualities of the horned, with even superior propensity to fatten, and much greater quietness and docility."

Professor Low, p. 333, says of them,—

"Extending from Fifeshire westward to the Ochil Hills, the cattle are generally hornless, and of a size intermediate between the breeds of the Highland mountains and those of the plains. Some of these cattle, especially those of the Ochil Hills, are really good, and suited to the country in which they are reared, and merely demand that attention to the selection of the breeding parents which shall call forth their more useful properties."

Mr. Dickson, in his work on live stock dated 1851, but which also refers to the beginning of the century, says of this polled breed, it is "unlike any others in Scotland;" it "is of good size and substance, and rather coarse, but equally suitable for shipping. Lays on flesh very well, and seldom deceives the butcher in weighing." Dickson ranks this breed as one of the "four distinct polled breeds in Scotland."

Of them the late Charles Stevenson, editor of the *North British Agriculturist*, wrote, in 1863,—

"At no very distant date there existed, extending from the west of the Ochils to the east of the Lomond Hills, in the county of Fife, a very valuable breed of polled cattle for the dairy. The colors were brown, brown and white, black and white. As dairy

stock, they were equal to the Ayrshire in quantity, while the quality was superior."

"*Highland Humlies.*"—In Mr. McCombie's early days "there was a race-starved vermin which were known by the name of 'Highland Humlies,' which I consider the worst of all breeds. No keep will move them much. At the top of these I must place those with the brown ridge along the back. They can be made older, but it takes more ability than I ever had to make them much bigger. Keep is entirely thrown away on them."[1]

The following extract officially and accurately summarizes the state of the polled breeds in Scotland in 1860. It is taken from the "Introduction—General View of Scotland," p. xiv. of Nelson's "Hand-Book to Scotland," by Rev. John M. Wilson, author of the "Imperial Gazetteer of Scotland":

"Three breeds of hornless cattle, the Galloways, the Angus humlies, and the Buchan, grazing the districts from which they take their name, together with contiguous ones, are known in the English shambles. A large-horned breed, called the runts, common in Fifeshire and Aberdeenshire, serve chiefly for salted beef."

The Angus and the Buchan polls have long been amalgamated, as they are radically of the same race, territorially belonging to the same geographical Caledonian region, so distinct and separate from the southern and Border region.

Curious Description of Orkney Cattle.—A manuscript of date 1529, in referring to the Orkney cattle, says . . . "the oxen be yoaked with cheats and haims and breachams, which they call weases, albeit they have horns." The last clause might lead one to suppose that the writer had only been accustomed previously to hornless cattle.

[1] Cattle and Cattle Breeders. 4th ed. By Wm. McCombie, of Tillyfour, M.P.

(To be continued.)

RECENT LITERATURE.

Sixth Annual Report of the U. S. Geological Survey.[1]—The sixth annual report of the survey under Major J. W. Powell is issued two years after the period to which it refers, and hence the accounts of progress which the volume contains are somewhat antiquated by the time they reach the public. This, however, is presumably the fault of the government printing-office, and not of the survey. Old as the news thus is, a few data may not prove uninteresting. The annual report for the fiscal year ending June 30, 1885, shows that the expense of the survey aggregated within a few hundred dollars of the appropriation of half a million. During the year, the topographical survey was completed and maps prepared for the engraver of fifty-seven thousand square miles of territory, at an average expense of three dollars per square mile. The usual administrative reports by the heads of the divisions appear in their proper sequence, and from them we learn that in the future relief-cuts are to be used as much as possible in the illustration of the publications of the survey,—a decision which is to be commended when such good results are obtained as in the present volume. This will render it possible to use the same cuts over and over again when it is necessary, and also places electrotypes at the disposal of the survey. All of the heads of divisions, with one exception, enumerate their assistants, other than clerical, by name, and detail the work upon which they have been employed. A similar course in the other instance would give credit to several workers to whom it is certainly due.

The accompanying papers are five in number. Mr. L. F. Ward discusses the "Flora of the Laramie Group," and describes, from the leaves alone, many species of fossil plants. Mr. J. S. Curtis describes his modification of Plattner's method of quantitative determination of silver in an assay. The new apparatus described reminds one of the mechanical stages found on some microscopes. The three remaining papers need a much more extended notice than our space will allow.

In Southwestern Wisconsin is found an area of about ten thousand square miles which exhibits no traces of former glacial action, while all around it, for several hundred miles in every direction, all the phenomena of former glaciation are abundant. This was, as it were, an island in the great sea of ice which covered the whole northern part of the continent. Messrs. Chamberlain and Salisbury have been studying this driftless area, and their accounts are given in this report. They are, apparently, painstaking researches upon all the phenomena exhib-

[1] Sixth Annual Report of the United States Geological Survey to the Secretary of the Interior, 1884–85. By J. W. Powell, Director. Washington, 1885 [1887].

ited in the region, and, while one may not agree with all their conclusions, the paper will always have a value in connection with the question of several successive glaciations and of the formation of the loess. Their explanation of the cause of this driftless area is the same that has been advanced before,—a division of the continental ice-sheet by the high land to the north, and existence of lower channels to the right and left. This was supplemented by other influences the value of which it is difficult to estimate.

Professor Shaler's study of the phenomena exhibited by the sea-coast swamps of the eastern United States is also a valuable contribution to dynamical geology. The steps, as he traces them, in the formation of a salt-marsh are first, the deposit of mud by the currents in some sheltered spot, and next, the growth of eel-grass on the mud-flats thus formed. This in turn entangles still more mud, and soon the level is raised to where other plants can grow. This process is still further complicated by the formation of sand-beaches and sand-dunes, and of these two, or even more, may be formed in succession, broken here and there by openings for the drainage of the marsh behind.

Captain Dutton's paper on the "Geology of Mount Taylor and the Zuñi Plateau of New Mexico" gives the results of six years' studies in this region,—studies which are not easily reproduced in abstract, so strange is the region described. Here were found that peculiar type of volcanic action termed by Gilbert "laccolites;" dikes of volcanic material abundant around the edge of the plateau, but rare in its interior; carboniferous strata resting directly upon those of Cambrian age, and a series of mountain-peaks and necks not easily paralleled in other parts of the world, other than this strange western region which the past twenty years have shown to be so wonderful from every geological point of view.

Packard's Fossil Arthropods.[1]—Dr. Packard has for some time been engaged in the study of fossil arthropods, and in these two memoirs gives us the results of his latest studies, the outlines of which have already been presented in the pages of the NATURALIST. The Syncarida, a proposed new group, is assigned a place intermediate between the decapods and tetradecapods. To the reviewer it would seem that the forms included are true Amphipoda, and that "Syncarida" can at most have but family rank. A wider knowledge of existing amphipods would have

[1] "On the Syncarida, a hitherto undescribed Synthetic Group of Extinct Fossil Crustacea;" "On the Gampsonychidæ, an undescribed Family of Fossil Schizopod Crustacea;" "On the Anthracaridæ, a Family of Carboniferous Macrurous Decapod Crustacea;" "On the Carboniferous Xiphosurous Fauna of North America." By A. S. Packard Fifteenth and sixteenth memoirs of vol. iii. of the Memoirs of the National Academy of Sciences. 1887.

shown Dr. Packard that his definition and limitation of that group is extremely faulty. Dr. Packard's new family, Gampsonychidæ, is apparently valid, and belongs, where he has placed it, among the Schizopoda. In his paper on this group we observe that he regards his Syncarida as an ancestor of the schizopods. It is not easy to see how our knowledge of crustacean embryology supports such a view, for in development a schizopodal condition usually precedes the single-branched appendage. So far as the plates show, there is nothing except the telson to separate the family Anthracaridæ from the true Caridea, or to indicate that it differs from any existing group. The telson, however, is greatly different, approaching most closely in its appearance to that of the existing genus Euceramus of Stimpson.

The paper on the "Xiphosura of the Carboniferous" is the best of the series, containing as it does, in addition to the description of new forms, a *résumé* of our previous knowledge. It would seem, however, that the reference of *Cyclus americanus* to the genus Cyclus is hardly warranted. Except in the possession of a circular outline, Cyclus and the form in question have little in common. With regard to the other forms described or redescribed by Dr. Packard, but little needs to be said. The relegation of Euproops into synonymy seems warranted, but the sub-order Synziphosuridæ, with its four new families, should have, at most, but family rank. For the Merostomata and Trilobites Dr. Packard proposes a class, Podostomata, the definition of which could be very seriously criticised. The most prominent point, however, to be mentioned is that Dr. Packard, in this new group, actually renames one of his own groups, which in turn was well enough named before. A slight variation in the limits of the Gigantostraca of Haeckel and Dohrn makes this group synonymous with the later Palæocarida of Packard, while, so far as we can see, Packard's Palæocarida and Podostomata are absolutely identical.

In closing this review, we may call attention to a tendency on the part of our author to rename things already well named, and his pages fairly bristle with "arthrosome," "bænopod," "urosome," "cephalula," and the like,—all synonymous with previously-coined and widely-used terms. The learning of this new nomenclature, in order to read intelligently one of Dr. Packard's later productions, is, as suggested by Col. Theodore Lyman in another connection, extremely like sawdust-swallowing,—neither palatable nor nutritious.

Thomas on Mammalian Dentition.[1]—The reader who expects

[1] On the Homologies and Succession of the Teeth in the Dasyuridæ, with an attempt to trace the History of the Evolution of Mammalian Teeth in General. By Oldfield Thomas (British Museum). Philos. Transac. Royal Society, 1887, p. 443.

to find in this memoir a history of the evolution of Mammalian dentition will be disappointed, for it embraces only a history of the evolution of the milk-dentition and the nature of dental succession. To this end the author has written a very useful paper, and illustrates it with numerous instructive diagrams and figures. He first describes the dentition of the Dasyuridæ, and shows how the third, or, as he calls it, the fourth, superior premolar has disappeared, leaving but three in the genera Dasyurus and Sarcophilus. As Mr. Thomas calls the fourth superior premolar in the Marsupialia a true molar, he finds only two left in the genera named, and, believing that four premiolars must be accounted for, he endeavors to show that another premolar has been lost in those genera. He concludes that the second is the missing one, and reaches this opinion by finding on one side of a single skull of *Phascogale dorsalis* a supernumerary tooth between the first and second premolars. In our opinion, this supernumerary tooth, if anything more than an abnormality, can only represent a former tooth of a series of five. Similar teeth have been observed in the inferior series in *Miacis edax* Leidy, and *Coryphodon latidens* Cope. It is quite unnecessary to complete the number of four premolars, since four are accounted for, after the replacement of the third, which is wanting in Dasyurus. The fourth is of molariform structure, and has been therefore regarded as a true molar by Flower and Thomas. The fact that it is in the genus Triïsodon and probably others (as Mioclænus, where there are four inferior premolars), shed and succeeded by a premolariform permanent tooth, is conclusive as to the homology, as I have pointed out.[1] Mr. Thomas finds my description of this genus "incomplete and confusing," and the reason why he does so is apparent from the above description of his views.

Mr. Thomas believes that the milk-dentition is not a remnant of a primitive succession derived from Reptilian ancestors, but holds, with Professor Flower, that it is a superaddition gradually introduced in the evolution of the Mammalia. The lack of milk-teeth other than the third premolar (or its homologue), from the Jurassic Mammalia, strongly supports this view. The fact that the temporary fourth premolar is in most placental Mammalia more complex than its permanent successor, is also in favor of this view, so far as it goes; and the fact that this complex tooth is permanent in the implacentals still further supports the opinion of Flower. On this view it appears that the placental has added to the implacental milk-dentition one tooth posteriorly and two anteriorly. It then looks as if the deciduous dentition consisted of primitive teeth retarded in their protrusion by more precocious ones. This is essentially Mr. Thomas's explanation,—which approximates that of Baume, who, however, differs in the method

[1] Final Report U. S. Geol. Survey Terrs., iii. Bk. i. p. 270, 1885.

of statement. Baume[1] regards the milk-dentition as expelled by the crowding of the germs of the permanent teeth in the jaws, and so caused to protrude earlier. The opinion of Thomas is preferable, since teeth of accelerated growth will certainly retard or repress germs of slower growth, and not weaker germs expel stronger germs, as Baume's theory requires. Moreover, milk-teeth appear at normal age for teeth, while the permanent ones are late. Mr. Thomas finds difficulty in accounting for such precocity and such crowding. Mechanical evolution furnishes the explanation. It is due to the shortening of the jaws; and this is a consequence of the development of the canine teeth from use, and the consequent forward movement of the masseter muscle and its insertions.[2]

It may be observed that the unnecessary terms Prototheria and Eutheria, which are generally ascribed to Professor Huxley in England, were really introduced by Professor Gill.[3]—*E. D. Cope.*

Jordan's Science Sketches.[4]—When Dr. Jordan undertakes the description of a fish his language is the language of science; when he turns his pen to the popularization of scientific subjects he still retains his former conciseness, but at the same time he manages to introduce many epigrammatic sentences and no little quiet humor, the latter the more enjoyable from the thoroughly natural manner in which it is used. His recent book, "Scientific Sketches," is made up of a series of articles, lectures, and addresses, most of which have appeared separately before, but which are welcome in permanent shape. Four of the sketches relate to fishes, dealing with the life of a salmon, the habits of the "John Darters," a sketch of the salmon family, and the dispersion of fresh-water fishes. Three are biographical sketches, the subjects being Rafinesque, Poey, and Darwin. The "Story of a Stone" is a bit of geological history for young readers; the "Ascent of the Matterhorn" is the least scientific, the "Nomenclature of Birds" the least popular, of the essays. The last essay in the volume, "The Evolution of the College Curriculum," is by far the most valuable, but to be fully appreciated it should be read in the light of the experiment in collegiate instruction which is being tried at the Indiana University, of which Dr. Jordan is the president. Dr. Jordan's idea is that a college should provide both the facilities for a general culture and also for detailed study; that, while teaching the elements of

[1] I only know this from Schlosser's description, Morphologishes Jahrbuch, 1886, p. 110.

[2] See Cope, The Mechanical Origin of the Sectorial Dentition, Proceeds. Amer. Assoc. Adv. Sci., 1887.

[3] Arrangement of the Families of Mammals, Smithsonian Contributions to Knowledge, 1872, pp. v., vi.

[4] Science Sketches. By David Starr Jordan. Chicago: A. C. McClurg & Co. 1887.

several subjects, it should give each student a thorough drill in some one branch. The scheme has been thoroughly worked out on paper, but time alone can tell how it results. It must be said, however, that it has amply satisfied its advocates during the two years that it has been tried.

Hepaticæ Americanæ.—The first twenty numbers (Decades I. and II.) of this distribution, by Dr. L. F. Underwood and O. F. Cook, were received in the latter part of November. The species represented are as follows, viz.: 1. *Riccia natans* L.; 2. *Marchantia polymorpha* L.; 3. *Conocephalus conicus* (L.) Dum.; 4. *Anthoceros lævis* L.; 5. *Blasia pusilla* L.; 6. *Steetzia lyellii* Lehm.; 7. *Frullania grayana* Mont.; 8. *Lejeunia serpyllifolia* Lib., var. *Americana* Lindb.; 9. *Madotheca porella* (Dicks.) Nees.; 10. *Radula complanata* (L.) Dum.; 11. *Ptilidium ciliare* (L.) Nees.; 12. *Bazzania trilobata* (L.) B. Gr.; 13. *Trichocolea tomentella* (Ehr.) Dum.; 14. *Lepidozia reptans* (L.) Dum.; 15. *Kantia trichomanis* (L.) B. Gr.; 16. *Geocalyx graveolens* (Schrad.) Nees.; 17. *Cephalozia curvifolia* (Dicks.) Dum.; 18. *Jungermania schraderi* Mart.; 19. *Scapania nemorosa* (L.) Dum.; 20. *Plagiochila porellioides* Lindenb.

The specimens are carefully selected, and are neatly labelled. As will be seen, they represent the four orders of Liverworts, as well as all the larger genera. The set is well worth the price asked for it ($1.25). It may be obtained of Dr. Underwood, at Syracuse, N. Y. Teachers of botany will find this set a valuable one for their beginning classes.—*Charles E. Bessey.*

GENERAL NOTES.

GEOLOGY AND PALÆONTOLOGY.

The Sonora Earthquake of May 3, 1887.—On the afternoon of May 3, 1887, at 2.12 Pacific time (=120° W. of Greenwich), the first of a series of earthquake movements was felt in the State of Sonora and the adjacent parts of Mexico and the United States, over an area extending from El Paso in Texas on the east to the river Colorado and the Gulf of California on the west, and from the State of Sinaloa on the south as far north as Albuquerque in New Mexico; the extremes in both directions being over five hundred miles. It was the fortune of the writers to be at the time at the great copper-mining camp of Bisbee in Arizona, in a narrow gorge of the Mule Pass Mountains, about five thousand three hundred feet above the sea, and near the border of Sonora. A violent tremor of the earth, including two sharp shocks, and lasting over ninety seconds, was succeeded at fre-

quent intervals by many lesser movements in the next three days, and less frequently at least up to May 29. In this part of Arizona solid house-walls, of *adobe*, or unburned brick, were cracked or overturned, while huge rocks in the steep mountain gorges rolled down, causing much damage. Fires, perhaps kindled by these in their course, appeared immediately afterwards in various wooded regions in Sonora and Arizona, giving rise to many false rumors of volcanic eruptions. The movement here seemed from south to north; the Sonora railroad track in one place near the frontier, running east and west, was displaced three inches to the north; while a chimney-shaft, without being overturned, was turned violently around upon its base. The small town of Bavispe in the Sierra Madre, in Sonora, was nearly destroyed, many people being killed and wounded. Opoto suffered in a similar way, and Fronteras to a less extent. The district chiefly affected by the earthquake is, however, for the most part a desert, with some cattle-ranches and mining stations.

Interesting studies were made by the authors in the valleys, or *mesas*, between the parallel mountain ridges in this region, both in the San Pedro and Sulphur Spring Valleys. The latter, lying to the east of Bisbee, and stretching north and south about one hundred miles, is often eight or ten miles wide, and has its lower portion in Sonora. Though without a visible water-course, water is there generally found at depths of from ten to forty feet in the numerous wells sunk at intervals to supply the needs of large herds of cattle. As described by many observers, the surface of this plain was visibly agitated by the first earthquake shock, so that persons were in some places thrown down by the heaving of the soil, which burst open, with discharges of water, while the wells overflowed and were partially filled with sand. In the southern part of this valley, for about seven miles south from the Mexican frontier, the authors found the results of the undulatory movement of the soil apparent in great numbers of cracks and dislocations. For distances of several hundred feet, along some lines with a generally north and south course, vertical downthrows on one side, of from one foot to two feet and more, were seen, the depressed portion rising either gradually or by a vertical step to the original level. Branching, and in some cases intersecting, cracks were observed. These depressions were evidently connected with outbursts of sand and water, which, along cracks,—marked by depressions on both sides,—sometimes covered areas of many hundred square feet with layers a foot or more in depth, marked here and there by craters two feet or more in diameter, through which water had risen during the outburst of these mud volcanoes. The authors examined many of these phenomena in Northern Sonora, and took photographs, which were exhibited. They note that while the

earthquake movements in the adjacent hills of Palæozoic strata had left no marks, the dislocations over many square miles in the valley would have sufficed to throw down buildings and to cause great loss of life in an inhabited region. There are believed to be no evidences of previous earthquake disturbances in this region since its discovery by the Spaniards centuries ago.

From the published reports of commissioners named by the State of Sonora it appears that the regions injured by the earthquake are in two nearly parallel north and south valleys in the district of Moctezuma, along the river Bavispe, a tributary of the Yaqui. The town of Bavispe itself, of fifteen hundred souls, lies about seventy miles south of the American frontier and one hundred and ten miles southeast of Bisbee, Arizona; its elevation being three thousand and seventy feet above the sea. Here forty-two persons were killed and twenty-five wounded. Bacerao, twenty miles farther south, also suffered much damage, and the estimate for property destroyed in this valley was two hundred and eighteen thousand one hundred and ninety-nine dollars. Opoto, Guasalas, Granados, Bacudebachio, and Nacovi lie in a lower valley about thirty miles west of the last, the elevation of Guasalas being only seventeen hundred and twenty feet above the sea. The loss of life was here confined to Opoto, where nine were killed and six wounded. The injury done to property in this valley was estimated at seventy-eight thousand one hundred and fifteen dollars. In both regions are noticed the opening, in the arable lands, of numerous fissures, generally north or northeast in direction, from many of which water flowed abundantly. The river thus supplied in a time of excessive drought swelled to the volume usual in the rainy season of summer; a condition which lasted up to the time of the report of Señor Liborio Vasquez, dated at Bavispe, May 29, 1887. The fields had become green and the air moist with prevailing fogs. A report concerning the region of Opoto mentions not less than seven volcanoes in the vicinity, which were seen burning for two days, but without any flow of lava; while that for the Bavispe region declares that no volcano had there been discovered. The authors incline to the belief that, as was the case in the San José Mountains, and others examined by them along the borders of Arizona, the appearances of volcanoes near Opoto were due to forest fires.—*T. Sterry Hunt, LL.D., F.R.S., and James Douglas, M.A., Brit. Assoc. Adv. Science, Manchester,* September, 1887. *Abstract.*

Crinoid Beds at Crawfordsville, Indiana.—The principal belt of bed-rock running through Montgomery County, Ind., belongs to the Keokuk group of the Subcarboniferous period: it is in this formation that the celebrated crinoid beds are situated.

Below the Louisville, New Albany and Chicago railroad-bridge,

on the north bank of Sugar Creek, section 29, township 19 north, range 4 west, is seen a high bluff of sandstone, which has been left exposed by excavation. This sandstone forms the roof of the crinoid beds and overlies the blue shale in which the crinoids are found. These beds were discovered by the late Prof. E. O. Hovey, of Wabash College, in 1836. He first noticed the shale, which seemed to be full of crinoid stems and shells; he collected a number of these and exhibited them to his classes in college, afterwards he called public attention to them.

In 1842, Horace C. Hovey, son of Prof. E. O. Hovey, began to collect these crinoidal fragments, and while he was thus engaged he found the first crinoid head found at these beds. This specimen was an *Actinocrinus*.

Mr. R. K. Krout and Mr. Ira Crane visited these banks in the year 1851, and collected quite a number of specimens. Mr. Crane found, in the ravine, one of the finest specimens of *Onychocrinus exsculptus* that has ever yet been found; this specimen was pictured in the *Scientific American* of July 12, 1887.

Mr. O. W. Corey was the next person to visit the banks. He was an excellent machinist, but nature seems to have intended him to follow the "bent of his genius" in digging crinoids. He found first impressions of crinoids in the sandstone. This led him to think that below this sandstone, in the blue shale, specimens might be preserved, so he at once set to work, dug below this sandstone, and opened up a bed of fossils that has never yet had an equal. His first collection was bought for Wabash College by Horace C. Hovey, who raised the money by solicitation. Mr. Corey then discovered other places near this bed, and opened them also. From his labors the beds bear his name, and are known as Corey's Bluff.

Yale College hearing of Mr. Corey's career, at once set Professor Bradley at work. Professor Bradley was then working for Horace C. Hovey, when he was engaged by Professor Marsh, of Yale College.

Charles Dyer, an Englishman, who lived near Cincinnati, came here, and bought specimens and shipped them to the British Museum.

The beds were then purchased by Professor Bassett, who has taken out many hundreds of fine specimens.

The following is a list of the species of the Crinoidea found at this locality:

1881. *Agaricocrinus springeri* White. Ind. Rep., 1881.
1868. *Barycrinus herculeus* Meek and Worthen (*B. hoveyi* var. *herculeus*). Ill. Rep., vol. v.
1861. *Barycrinus hoveyi* Hall (*Cyathocrinus hoveyi*). Ill. Rep., vol. v.
1859. *Batocrinus indianaënsis* Lyon and Cassiday (*Actinocrinus indianaënsis*). Ill. Rep., vol. v.

1880. *Batocrinus wachsmuthi* White (*Actinocrinus wachsmuthi*). Ind. Rep., 1879–80.
1869. *Calceocrinus bradleyi* Meek and Worthen. Ill. Rep., vol. v.
1868. *Catillocrinus bradleyi* Meek and Worthen. Ill. Rep., vol. v.
1865. *Cyathocrinus arboreus* Meek and Worthen. Ill. Rep., vol. iii.
1879. (?) *Cyathocrinus harrisi* S. A. Miller. Journ. Cincin. Soc. Nat. Hist., vol. ii.
1869. *Cyathocrinus inspiratus* (?) Lyon. Trans. Amer. Philos. Soc., vol. xiii.
1859. *Cyathocrinus multibrachiatus* Lyon and Cassiday. Amer. Journ. Sci., vol. xxviii.
1870. *Cyathocrinus poterium* Meek and Worthen. Ill. Rep., vol. v.
1860. *Dichocrinus ficus* Cassiday and Lyon. Ill. Rep., vol. v.
1860. *Dichocrinus polydactylus* Cassiday and Lyon. Proc. Amer. Acad. Arts and Sci., vol. v. Syn. *expansus* Meek and Worthen. Ill. Rep., vol. v.
1858. *Forbesiocrinus wortheni* Hall. Rep. Iowa, vol. ii. part ii.
1859. *Ollacrinus tuberosus* Lyon and Cassiday (*Goniasteroidocrinus tuberosus*). Amer. Journ. Sci. and Arts, vol. xxviii.
1859. *Onychocrinus exsculptus* Lyon and Cassiday. Syn. *Onychocrinus* (*Forbesiocrinus*) *norwoodi* Meek and Worthen. Ill. Rep., vol. ii.
1859. *Onychocrinus ramulosus* Lyon and Cassiday. Amer. Journ. Sci., vol. xxviii.
1865. *Platycrinus hemisphericus* Meek and Worthen (*Pleurocrinus*). Ill. Rep., vol. iii.
1870. *Poteriocrinus concinnus* Meek and Worthen (*Pot.* (*Zeacrinus*) *concinnus*). Ill. Rep., vol. v.
1870. *Poteriocrinus* (*Decadocrinus*) *depressus* Meek and Worthen (*Scaphiocrinus depressus*). Ill. Rep., vol. v.
1869. *Poteriocrinus* (*Scaphiocrinus*) *coreyi* Meek and Worthen. Rep. Ill., vol. v.
1878. *Poteriocrinus* (*Scaphiocrinus*) *gibsoni* White. Proc. Acad. Nat. Sci. Phil.
1879. *Poteriocrinus* (*Scytalocrinus*) *grandis* Wachsmuth and Springer, described as *Poteriocrinus coreyi*. Ill. Rep., vol. vi.
1878. *Poteriocrinus* (*Scaphiocrinus*) *gurleyi* White. Proc. Acad. Nat. Sci. Phil.
1865. *Poteriocrinus* (*Scaphiocrinus*) *Indianaënsis* Meek and Worthen. Ill. Rep., vol. iii.
1861. *Poteriocrinus nodobrachiatus* Hall. Bost. Journ. Nat. Hist., p. 614.
1861. *Poteriocrinus* (*Scytalocrinus*) *robustus* Hall. Bost. Journ. Nat. Hist., p. 315.
1879. *Poteriocrinus* (*Pachylocrinus*) *subæqualis* Wachsmuth and Springer. Ill. Rep., vol. v.
1861. *Poteriocrinus* (*Scaphiocrinus*) *unicus* Hall. Ill. Rep., vol. v.

1858. *Taxocrinus multibrachiatus* Lyon and Cassiday (labelled in most Amer. collections *Forbesiocrinus meeki* Hall). Amer. Journ. Sci., vol. xiii.

1861. *Vaxocrinus lyoni* Hall (*Cyathocrinus lyoni*) Meek and Worthen. 1868 (*Barycrinus lyoni*). Proc. Acad. Nat. Sci. Phil. Syn. *Cyathocrinus hexadactylus.*—*Chas. S. Beachler.*

The Carboniferous Genus Stereosternum.—The reception of a nearly entire specimen of the remarkable reptile *Stereosternum tumidum* Cope, from San Paolo, Brazil, through Professor Orville Derby, enables me to add a number of characters to those already known. The sternal region presents a large coracoid on each side posteriorly, and a transverse element anteriorly. Whether the latter is clavicle or the transverse limbs of a large interclavicle, is uncertain. The foramen of the humerus is *external.* The carpus consists of a radiale, a large intermedium, and a small ulnare; a large centrale and four tarsalia, the external related to two metapodials. The thumb is more robust than the four other digits. The neck is moderately elongate, and includes nine vertebræ besides the atlas. The vertebræ have robust transverse processes and slender cervical ribs. The skull is elongate and acuminate, and its bones are apparently fragile. Little of its structure can be made out. The teeth are slender, acute, and nearly straight, and are planted in (?) shallow alveoli.

The characters of the scapular arch differ from those of the Theromorpha. This character, with the different tarsus and rib-articulation, indicates that Dr. Baur's order Proganosauria, proposed for this type, is well founded. The lacertilian character of the ectepicondylar foramen of the humerus must be also remembered.—*E. D. Cope.*

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—In an exceedingly interesting paper recently published, Dr. A. Lagorio[2] discusses some of the fundamental principles relating to the nature of the glassy base of porphyritic rocks, the succession of crystallization in rock-magmas, and the classification of rocks. He emphasizes the thought that the geologist must ask the aid of chemistry and physics in solving the problems which present themselves to him. He must obtain all the light that these kindred sciences can lend him, and in this light must approach the hidden mysteries locked up in the depths of rock-masses, and must examine them with the critical eyes not merely of the geologist, but of the chemist and physicist as well. We may then, he thinks,

[1] Edited by DR. W. S. BAYLEY, Madison, Wisconsin.

[2] Miner. u. Petrog. Mitth., viii., 1887, p. 422.

obtain some knowledge as to the origin of rocks, their relations to each other, and the causes of the great variation in structure observed in them. The paper is full of interesting facts and valuable suggestions. It begins with a discussion of the theory proposed by Rosenbusch to account for the successive crystallization of rock-constituents. It has been recognized for a long time that the minerals in a rock did not crystallize in the inverse order of their fusibility, as might at first thought be expected. The order in which the separation takes place bears no relation to the temperature of solidification. Rosenbusch regards the acidity of the minerals as the important element governing their crystallization. He states, as a general law, that the order of the separation of the minerals from a rock-magma is inversely as their acidity. Roth[1] has called attention to the very many exceptions to this rule, and in its place gives seven empirical laws of association. Lagorio refuses to accept Rosenbusch's law, and proceeds to investigate the subject by chemical methods. He analyses the glassy ground-mass and crystallized portions (Ausscheidungen) of artificial and natural glasses, and thoroughly discusses the figures thus obtained. He finds that the *sodium-silicates* possess a stronger tendency to crystallize from a molten magma than do the corresponding isomorphous potassium compounds. Sodium is concentrated in the crystallized portions, and potassium in the residual ground-mass. With this discovery as his governing principle, Lagorio examined rocks varying widely in their composition and structure. Upon discussing the figures which these analyses yield, the following conclusions are reached: (1) A rock-magma is a more or less completely saturated solution of different silicates. (2) The normal glass—that in which all the other silicates are dissolved, or, more precisely, the last substance to crystallize from a molten rock or glass-magma—is a silicate of the composition $K_2O.2SiO_2$. This compound is capable of holding in solution silica, magnesia, lime, alumina, and iron-oxides, and from this solution the minerals separate out in a certain order, which is determined by the different amounts of the elements in solution and their affinity for each other, the sodium-bearing minerals always crystallizing before the corresponding potassium-bearing compounds. (3) The order of solubility of various compounds in the normal glass is: potassium compounds; sodium-silicates; calcium-, magnesium-, iron-salts; and, finally, oxides of the heavy metals, the latter being the most soluble. The greatest amount of supersaturation obtains in the case of the most soluble compounds. From such a supersaturated solution—a rock-magma—minerals separate in the order of the excess of saturation,—viz., the oxides of the heavy metals first, then the silicates of the heavy metals, then sodium-silicates, and, finally, quartz and the potassium-

[1] J. Roth, Chem. Geologie, ii. pp. 49 and 69.

silicates. (4) The stronger tendency of sodium compounds to separate, as compared with potassium compounds, is seen in the case of the sodium-bearing hornblendes and augites. (5) Sanidine crystallizes from a molten magma only after the relative proportions (molecular) of K_2O and Na_2O in it become as 2 : 1. (6) The affinity of the elements for each other is an important factor in determining the order of crystallization. Calcium and sodium are widely found associated in the same minerals, magnesium and sodium rarely. Potassium, on the other hand, occurs frequently with magnesium, rarely with calcium, etc. (7) The order of crystallization is as follows: Oxides, pure Fe-silicates, Mg-silicates, Fe + Mg-, Mg + Ca-, Mg + K-, Ca-, Ca + Na-, Na-, K-silicates, and, finally, silica, which latter, however, frequently separates out before or contemporaneously with the potassium-silicates. (8) The composition of a second generation of minerals in a porphyritic rock is dependent upon the composition of the residual magma at the time of their solidification, and not upon a recurrence of the conditions under which the corresponding minerals of the first generation were produced. (9) The more or less complete development of the constituents of the ground-mass of a rock is but slightly, if at all, dependent upon the rapidity with which the original magma cooled. In addition to these results obtained by a study of the composition of the different portions of a rock, Lagorio also discusses several theoretical questions of general interest. He believes that the hornblende and mica in rocks were formed in the presence of water[1] and under pressure. The existence of basic hydrogen in many members of the mica group, he thinks, would indicate this fact. He also criticises many of Rosenbusch's statements as to the origin of the plutonic rocks, which, Lagorio says, were originally eruptive or intrusive, but in their present condition are metamorphic. In conclusion, attention is called to the system of classification proposed by Rosenbusch[2] for the massive rocks, and some of the hypotheses upon which it is based are shown to have no foundation in fact. The paper, as a whole, is an admirable one, and bears evidence of care in its preparation. It is to be hoped that it will act as an incentive to more work in the direction of experimental and chemical geology.——In a late number of the *Quarterly Journal of the Geological Society* Mr. Rutley[3] has a paper on the rocks of the Malvern Hills, which, upon the occasion of its delivery before the society, gave rise to considerable debate. Mr. Rutley describes in detail the structure of the Malvern Hills, and gives two plates illustrating his views. The rocks of the range he divides into three classes,—eruptive, foliated, and stratified. The first consists principally of diorites, diabases, gabbros and granites, and felsites. These he describes

[1] *Cf.* American Naturalist, 1886, p. 160.
[2] Ib., February, 1887, p. 172.
[3] August, 1887, p. 481.

singly. The most notable fact in their consideration is the supposed occurrence of topaz in the felsite and the grouping of little crystals of this mineral in such a manner as to bring out the pearlitic structure of the rock. The second class the author "is inclined to regard . . . as probably being more or less altered volcanic tuffs, or as sedimentary rocks mainly composed of eruptive material derived from the disintegration of rocks of a dioritic or syenitic character." Various reasons are given for this conclusion, none of them, however, being based on petrographical evidence. The stratified rocks embrace tufas and quartzite.——Bergeron[1] mentions the occurrence of hyperite in the carboniferous of Aveyron, near the village of Arvieu. It contains intergrowths of hypersthene and diallage, in which $\infty P\grave{\infty}$ of the hypersthene is parallel to $\infty P\infty$ of the diallage. The large crystals of hypersthene exhibit pressure effects to such a degree that the broken pieces of this mineral have been separated from each other, and between them have been injected portions of the granulitic ground-mass. The minerals comprising this ground-mass are round, and possess no crystal outlines. The smaller grains consist of pyroxene, which tends to group itself around the larger crystals of hypersthene, forming an aureole. The larger grains of the ground-mass are labradorite.——E. Cohen[2] has recently called attention to the fact that andalusite occurs much more frequently as an accessory mineral in normal granite than had formerly been supposed. He mentions five granites from the Vosges, Croatia, the Schwarzwald, and Vogesen, each of which contains more or less andalusite, but in quantity too small for isolation. In an aplitic tourmaline granite from Alt Zschillen, near Wechselburg, in Saxony, Cohen finds it in sufficient quantity for isolation, but not for analysis. The mineral occurs in isolated columnar and acicular forms, and not in groups, as in the case of contact rocks and the crystalline schists.

Mineralogical News.—After experimenting upon the effect of high temperatures on the optical properties of *faujasite* crystals, Rinne[3] concludes that this mineral is normally regular in crystallization. When exposed to the air it begins to lose water and becomes uniaxial, breaking up at the same time into eight individuals, each extending from an octahedral face into the centre of the crystal. These individuals are positively refractive, and their optical axes are perpendicular to the octahedral faces. When heated in contact with the air the difference between the index of refraction of the ordinary ray and that of the extraordinary ray becomes less and less as the temperature increases, until at 150° $\omega = \varepsilon$. At this temperature the mineral loses 16.83

[1] Comptes Rendus, cv., 1887, p. 247.
[2] Neues Jahrb. f. Min., etc., 1887, ii. p. 178.
[3] Ib., i. p. 17.

per cent. of water,—equivalent to twelve molecules. Above 150° the mineral remains uniaxial, but refracts negatively. When thin sections of the mineral are allowed to cool in the air they revert to their original condition of positive refraction, but if cooled under balsam (protected from the air) they remain negatively refractive. Faujasite, therefore, passes from the regular system to a crystallographic system of a lower degree of symmetry upon loss of part of its water. *Heulandite* from Andreasberg, on the contrary, is monoclinic under ordinary conditions. When heated to 150° it loses two molecules of water and becomes orthorhombic. It regains its original condition if submitted to the action of the atmosphere. This peculiarity of the Andreasberg heulandite is supposed by Rinne to be due partly to the large amount of strontium it contains, and its consequent approach in composition to brewsterite, which is known to possess peculiarities similar to those described. Jannasch, who has examined the heulandite from Andreasberg,[1] finds that it does in reality contain a large amount of strontium. ——Sandberger[2] thinks that, whatever might be the origin of *graphite*, it can certainly not have been produced in any igneous way. In studying Ceylon specimens of this mineral, he has discovered pieces on the $\infty P\infty$ faces of which are numerous little *rutile* crystals cutting each other at an angle of 60°, in the manner so frequently seen in mica. Had the temperature at the time of the formation of these crystals been high, he argues, they would have been reduced to the metallic state in the presence of such great excess of carbon. He also finds that many of the minerals associated with the graphite are covered with a coating of this mineral. Among the minerals thus covered may be mentioned quartz, orthoclase, mica, and apatite. Upon removing the outside shell of graphite from around the apatite, this mineral was seen to be marked with the outlines of the rutile needles imbedded in the graphite. This, says Sandberger, is an indication that the latter mineral was formed before the apatite had become hard.——In an article on the minerals of the Tyrol Cathrein[3] describes *grossularite* crystals, which, when broken open, are seen to consist of alternate zones of garnet and bluish calcite, of which the internal zones of garnet differ from the external zones both in color and composition. He examines also the so-called *paragonite* from Greiner (Zillerthal), and finds it to possess the ideal composition of talc. Cathrein also describes pseudomorphs of *fassaite* and *garnet* after gehlenite. The garnet pseudomorphs here described are the first known cases of the pseudomorphic origin of garnet. According to Klein and Jannasch,[4] the *ullmanite* (NiSbS) crystals from Lõl-

[1] Neues Jahrb. f. Min., etc., 1887, ii. p. 39.
[2] Ib., p. 12.
[3] Miner. u. Petrog. Mitth., viii., 1887, p. 400.
[4] Neues Jahrb. f. Min., etc., 1887, ii. p. 169.

ling (Carinthia) and from Sarrabus (Sardinia) possess the same chemical composition. The mineral from Lölling, however, crystallizes in the inclined hemihedral division of the regular system, while the Sarrabus occurrence is parallel hemihedral. ——On *barite* crystals from the dolomite, near Volpersdorf, the four new planes $\infty P5$, $3P\infty$, $5P\infty$, and $\frac{1}{4}P2$ have been detected by Traube.[1]——Patton[2] studies crystallographically the *hornblende*, *oligoclase*, and *titanite* crystals in the druses of the Schriesheim diorite.——Igelström[3] describes the occurrence of braunite and hausmannite from the Sjögrube, in the Gouvernement of Oerebro, Sweden.——Ch. Lory[4] notes the occurrence of microscopic crystals of *albite* in various limestones and marbles from the Western Alps. Their origin, he thinks, is connected in some way with the specific nature of the calcareous deposits and with the conditions which produced their crystallization.

BOTANY.[5]

Character of the Injuries produced by Parasitic Fungi upon their Host-Plants.[6]—The first and most general injury which is produced upon plants by parasitic fungi results in consequence of the essential character of the fungus. Green plants have the power of converting inorganic materials into food for themselves. Fungi have not this power, but depend for their food entirely upon materials that have been previously elaborated by some green plant. Parasitic fungi take their food from their host while it is yet alive. The consequence to the plant, therefore, is a loss of food, a withdrawal of formed nutritive material, resulting, to greater or less extent, in starvation. In individual cells the contents usually suffer the greater injury, but the wall is also injured, as when penetrated by the haustoria, or suckers,—*e.g.*, upon the mycelium of Peronospora. But the special office of the haustoria is to absorb nutriment from the cell-contents. In some cases, as the above, the cell may live to be the continual prey of the parasite, and in some cases the cell is killed.

(2) While the food-supply of the plant is reduced, its power to replenish it is at the same time impaired,—*i.e.*, in case the fungus grows upon the green parts, as it does most frequently. The passage of light to the cells may be obstructed. The white moulds, or mildews, must obstruct it to some extent, black moulds growing over the surface, much more. The latter may occur either as true parasites, or as saprophytes upon "honey-dew."

Impaired nutrition weakens the physiological power of the chlorophyll. The life of the cells preyed upon is frequently

[1] Neues Jahrb. f. Min., etc., 1887, ii. p. 69.
[2] Ib., p. 261.
[3] Ib., p. 8.
[4] Comptes Rendus, cv., 1887, p. 99.
[5] Edited by Prof. CHARLES E. BESSEY, Lincoln, Nebraska.
[6] Read before Section F, A. A. A. S., August, 1887.

destroyed, and they become brown and dry, as in many species of Septoria, or crumble and fall out, leaving holes in the leaf, as frequently in *Puccinia asteris*. Where the injury is not so severe, spots of various colors, often characteristic of the species, mark more or less definitely the extent of the mycelium. Exposure to light and the activity of the chlorophyll may be lessened in another way, by a change in the position of the infested stems and leaves. A very common effect of a parasite is a more erect and rigid growth, as in blackberries diseased with *Cæoma nitens*, the orange-rust, and in the garden spurges, *Euphorbia maculata* and *E. hypericifolia*, infested with the cluster-cup, *Æcidium euphorbiæ*. These spurges normally grow prostrate, with leaves widely spreading, allowing the greatest possible exposure to sunlight. In the diseased condition the stems are erect and the leaves less favorably spread.

(3) Growth may be abnormally accelerated or retarded, and both these effects may be produced in different cases by the same fungus. *Peronospora parasitica* growing upon the common pepper-grass, *Lepidium virginicum*, forms a thick, felted coating of hyphæ upon the under surfaces of the leaves, and causes the latter to be somewhat contracted. The same fungus growing upon the stems of *Sisymbrium canescens* causes swelling and distortion. The Æcidium on *Sambucus canadensis* distorts the stem by accelerating growth, the infested side becoming swollen and the stem bent.

Exobasidium vaccinii on species of Vaccinium causes the leaves to shrink; forms believed to belong to the same species, growing on Azalea and Andromeda, produce inflated sacs, often several inches in diameter.

A distortion usually consists of the fungus producing it and the abnormal tissues of the host, as illustrated in the smut of maize and the curl of peach-leaves. In the latter extra layers of cells are formed on one side.

Æcidium euphorbiæ accelerates the growth of the stems of its host and retards that of the leaves,—an effect resembling that of insufficient light upon plants, as upon vines on the shaded side of a trellis, or potato-sprouts in a cellar. The orange-rust on blackberries retards the growth of the leaves, as does also the cluster-cup upon *Ranunculus abortivus*.

Fusicladium, the scab-fungus of apples and pears, retards the growth often of one side, while that of the other continues, producing unilateral development and curvature of the axis of the fruit.

(4) Fungi are not confined to the chlorophyll-bearing parts of plants; woody stems, roots, flowers, seeds, and fleshy fruits all have their parasites. One of the Myxomycetes, *Plasmodiophora brassicæ*, causes the disease called club-root in the roots of cabbage. The appearance of the club-root of roses, which is

troublesome in American green-houses, suggests a similar cause. Among those on woody stems are the black knot on species of Prunus and the Gymnosporangia on cedars.

The flower is attacked in the case of the "double blossom" of blackberries, the smuts of many grasses (such as *Ustilago rabenhorstiana* on *Panicum sanguinale*), and other cases that will suggest themselves. Often the entire inflorescence is arrested in its development. Smut of Indian corn attacks both staminate and pistillate flowers, and the green parts as well. *Ustilago antherarum* upon Caryophyllaceæ produces its spores in the anthers. *Tilletia caries*, the bunt of wheat, destroys the inner structure of the seed, without much changing the external appearance. The majority of Ustilagineæ attack the inflorescence, flowers, and fruit.

The young ovary is affected in various ways. Ergot distorts it and produces an abnormal, horn-like mass of tissue; smuts convert it into powdery spores. Exoascus changes that of Prunus into a pouch. Fusicladium kills the newly-formed pear.

(5) The last case is also an example of the premature falling of diseased parts, apparently by the formation of the separative layer before its time. Such a falling of leaves is well illustrated by *Septoria ribis* upon the currant. On the other hand, diseased parts may remain green after the other parts have matured in the usual way. Ovaries of *Eragrostis poæoides* filled with *Ustilago spermophorus* are most readily detected by this sign. Probably this may be classed as retarded development.

(6) Many fungi cause decay of ripe fruit, both while attached to its plant and after removal, while still alive. From a practical stand-point, the injury to fruit may be of two kinds; it may affect simply the appearance, and hence the market-value, or impair the quality, when it does not entirely destroy. The scab of apples is injurious in either of these degrees.

Some fungi begin their growth as parasites under ordinary conditions, to continue it under conditions more like those which accompany saprophytic growth; in this connection may be mentioned the potato-rot, beginning its growth upon the green plant and sometimes completing it in the cellar, but upon the still living tuber.

(7) Some valuable plants are liable to infection from others of less value; a knowledge of this fact in individual cases may be of great practical utility, as a remedy may be more easily and effectively applied. It is easier to destroy wild grapes and Ampelopsis than to destroy Peronospora upon cultivated grapes which have suffered infection from the wild ones. This remedy especially commends itself when one stage of the fungus grows upon one kind of plant and another stage upon another kind, as do cedar-apples and orchard-rusts.

Perhaps no line of investigation in economic mycology prom-

ises better practical results than this. The relations of a few of the Uredineæ are known, as are also the relations of Ustilagineæ and the yeast-like forms which may be looked for in manure; but of the life-histories of the great group of "Fungi imperfecti," including many injurious species, almost nothing is known.

It is often difficult to estimate the extent of the injury to be attributed to any one of these causes, as several commonly operate together. Canada thistle attacked by *Puccinia suaveolens* wilts in hot sunshine, while healthy plants remain fresh; and this appears to be due chiefly to the first cause, the loss of nutriment, which weakens the physiological power. Is it possible that the breaking of the epidermis by the sori, in this or other cases, increases the rapidity of transpiration?

Farmers say the red rust of wheat produces comparatively slight injury, while the black rust is destructive. The black rust appears on the stems, which at that stage of growth have little chlorophyll, even if healthy; the formation of winter spores appears to make a greater drain upon the resources of the host than the formation of summer spores, which have much weaker vitality.

Certain groups of plants are the prey of certain groups of fungi. Gymnosporangia grow upon Cupressineæ; Ræsteliæ upon Pomaceæ; Phragmidia upon the sub-order Rosaceæ proper. Numerous species of Uromyces are parasitic upon Leguminosæ, and the grasses support more Pucciniæ than does any other family of phanerogams. In these two genera no species is known to produce its teleutospores upon host-plants belonging to more than one order. The large majority of Uredineæ grow upon herbaceous plants, as do Ustilagineæ and Peronosporeæ. In these groups a given species commonly inhabits but few species of host-plants, while some Erysipheæ inhabit a large number.

Many Erysipheæ grow upon woody plants. Fungi imperfecti are perhaps least of all to be classified with reference to hosts, though many of their genera may be. Woody plants have fewer active parasites than herbaceous plants. Water-plants and those of wet places are freer from attack than those which grow upon common soil.

To recapitulate, parasitic fungi injure their host-plants by (1) depriving them of nourishment; (2) impairing the power of assimilation; (3) abnormally accelerating or retarding growth, causing distortion; (4) not only green parts are affected, but roots, stems, inflorescence, flowers, and fruit; (5) leaves and fruit fall prematurely; (6) decay is produced in ripe fruits before and after removal from the plant; (7) valuable plants receive injury from those of less value by ordinary infection or heterœcism.

The amount of injury due to one cause is uncertain, since several act together.

Certain groups of phanerogams are liable to be attacked by certain groups of fungi.—*A. B. Seymour, Cambridge, Mass.*

ENTOMOLOGY.[1]

Phengodini.—The AMERICAN NATURALIST for September, p. 853, contains an interesting account of some of the metamorphoses observed in *Phengodes laticollis* Horn., by G. F. Atkinson. From the descriptions of the form of the female, its mode of life, and also of the egg, is but a counterpart of all these stages observed in Zarhipis. Indeed, without more definite and microscopic details, the descriptions of these stages in Phengodes would do quite as well for Zarhipis, showing how close these genera are.

On page 855 the description of the egg of Phengodes appears, and it applies so well to that of Zarhipis as to make me think there are no differences in the eggs of the species of the two genera; though a microscopic comparison would most likely reveal distinctive characters, and which must be done by some one before an analysis of the Phengodini can be written. The eggs of Zarhipis are round, smooth, semi-opaque, tinged with yellowish; size, 4 mm. diameter. They are not much unlike small slugs' eggs. As the sexes are so much unlike in form, the next interesting point to discover is at what stage is the sexual character first perceptible. Mr. Albert Kœbele and myself have each a nursery of broods of larvæ of Zarhipis that have gone through one moulting, and they all maintain the same form, and which is very like their mother.

Mr. Atkinson, on page 855, says, "The luminosity in this case is of sexual significance, attracting the males at night." This is a good observation, which explains a certain mode in Phengodes, but it would not do to say that that is the method in Zarhipis, when its habit is known to be diurnal. Mr. Kœbele informs me that he captured two examples of a Zarhipis in the night-time, allured by an electric light in the city of Los Angeles. This observation would make it appear that Zarhipis is also nocturnal in habit. The composition of the powerfully-diffused electric light is so good an imitation of that of day that it can hardly be considered conclusive testimony, in the face of the known diurnal habit of the insect.

The two sets of observation would go to show, if they are both correct, that Zarhipis possesses the double habit of simply flying in the day and seeking at night, at which time there is burning a sexual lamp to guide it, which lamp is a beacon planted upon the goal it is seeking. Zarhipis does not visit our gas- and oil-lamps like other Lampyridæ, or, rather, has not hitherto been found to do so. The mysteries of the Phengodini are still many in number, and it is to the Lampyridists of the South we look for the unravelment of those of Phengodes, and we in the West have to look after Pterotus and Zarhipis.—*F. F. Rivers, University of California.*

[1] This department is edited by Prof. J. H. COMSTOCK, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

Senses of Insects.—M. A. Forel[1] contributes a most interesting and exhaustive account of experiments made by himself and many others on the much-discussed problem of the senses of insects.

(1) In regard to the *sight* of ants, he notes especially these three conclusions: (*a*) They perceive light, and particularly ultra-violet (Lubbock); (*b*) they really see the ultra-violet rays, without eyes they are almost indifferent to them, and only respond to solar light more or less intense; (*c*) the dermatoptric sensations are feebler among the ants than in the animals which Graber studied.

(2) After reviewing new and old experiments as to the sense of *smell* in insects, he notes the following general facts: (*a*) In many insects which are essentially directed by sight, as in the Libellulids and Cicadas, the antennæ are rudimentary, and the sense of smell likewise. During the night these insects are passive, while during the day they trust to their power of sight, or possibly, in some cigalids, also to hearing; (*b*) the sensitive region, in spite of Graber's protestations, is situated in the antennæ, especially in those parts where the antennary nerve ramifies; (*c*) in certain insects, as in most Diptera, the antennæ serve almost solely for smelling purposes; (*d*) in other cases, however, where they are mobile, as in the Hymenoptera, they are used for detecting their food or their mates at great distances.

(3) As distinct organs of *taste*, M. Forel regards the nervous terminations (*a*) on the proboscis of flies (Leydig), (*b*) on the jaws and on the base of the tongue (Meinert), (*c*) on the end of the tongue (Forel), and (*d*) on the palate or on the epipharynx (Wolff).

(4 and 5) Forel's results as to *hearing* are, as yet, too negative to admit of notice. He finally discusses the sense of *touch* in its various manifestations, and the last chapter of his interesting memoir discusses the relation of the five senses to the general psychical life of insects.—*Four. Roy. Micr. Soc.*, 1887, p. 577.

ZOOLOGY.

Fresh-Water Sponges.—The *Proceedings* of the Philadelphia Academy of Natural Sciences for this year contain Mr. Edward Potts's monograph of "Fresh-Water Sponges." This paper contains, besides directions for collection and study, a translation of Vejdowsky's recent diagnosis of European Spongillids, a synopsis of all known North American species, and a *résumé* of all the known species of the world. The fifty-eight species are grouped in the genera Spongilla, Meyenia, Heteromyenia, Tubella, Parmula, Carterius, Uruguaya, Potamolepis, and Lubomirskia. The North American fauna embraces *Spongilla aspinosa*, *S. lacustris*, *S. fragilis*, *S. igloviformis* (nov.), *S. mackaya*, *S. novæ terræ*, *Mey-*

[1] Rec. Zool. Suisse, iv., 1887, pp. 161–240.

enia leidyi, *M. fluviatilis*, *M. robusta* (nov.), *M. milsii* (nov.), *M. subdivisa* (nov.), *M. baileyi*, *M. crateriformis*, *M. everettii*, *M. plumosa* var. *palmeri*, *Heteromyenia repens*, *H. argyrosperma*, *H. longistylis*, *H. ryderi*, *Tubella pennsylvanica*, *Carterius tubisperma*, *C. latitenta*, and *C. tenosperma*. Mr. Potts also describes as new *Parmula nesbyi* and *Meyenia minuta*, from South America. The paper is illustrated by eight well-executed process-plates of spicules, etc., of the species.

Arthropod Eyes.—The first number of Dr. Whitman's *Journal of Morphology* contains three articles dealing with the structure and growth of the eyes of arthropods. The first, by Dr. J. S. Kingsley, treats of the development of the compound eye of Crangon, an abstract of which appeared in the NATURALIST for November of last year. Dr. Kingsley claims that the compound eye arises as an invaginated pit of ectoderm, and that the retinal layers are inverted, the light traversing them in the same way as in the vertebrate retina.

The two other papers are by Dr. William Patten. The first, entitled "Eyes of Molluscs and Arthropods," is a summary of the results obtained by this author, and embodied in his longer paper in the *Mittheilungen* of the Naples Zoological Station for last year. The most important points brought out are that the whole of the so-called retinal elements of the compound eye are formed from a single layer of cells, and that this layer has not been inverted, as believed by Dr. Kingsley. He also shows that the rhabdoms of Grenacher are in reality formed by prolongations of the same cells which secrete the crystalline cones. According to his interpretations it follows that these eyes are not adapted for "mosaic vision," but that the nerve-fibres in the crystalline cones are the essential light and image percipient elements.

Dr. Patten's second paper deals with the development of the eyes of Vespa, and with some points in the structure of ocelli in insects. In the young embryos of Vespa the cephalic lobes present a thickening, which becomes pushed in and covered by an ectodermal outgrowth from the dorsal margin of the thickening. This thickening breaks up into at least six cords of cells, three of which ultimately enter into the formation of the optic ganglion, a fourth (dorsal to these) probably forms the antennal lobe, and the other two probably give rise to the mushroom bodies of the brain. While the foregoing steps are in progress a second thickening arises below the first, and sends inwards a process which forms the optic nerve. Then a shallow pit appears in the outer surface, and this becomes enclosed by a growth of ectoderm over it, so that this portion, which eventually forms the eye, in reality consists of three layers, the inner furnishing the retinal elements, which are erect, and not inverted as mentioned above in Crangon. Dr. Patten traces the development of the optic lobe from

the three cords of cells already mentioned, as well as the formation of the nerve-fibres and the inner and outer medulla. Besides this, he gives, but with less detail, the history of the retinal—or, to use the term with his significance, ommatidial—elements. In their history he agrees well with Dr. Kingsley.

Dr. Patten's paper contains a number of other observations. He shows that the median ocellus of Vespa arises as two ocelli, which later become fused together, while some points in the development of the compound eye (not mentioned here), as well as in the simple eyes of beetles, seem to prove that the compound eyes have arisen, not by a coalescence, but by a division of ocelli. Contrary to the views of Grenacher, Patten regards the ocelli of the larvæ of the water-beetles as practically closed vescicles, and composed primarily of three layers of cells, instead of open cups. In the posterior dorsal ocelli of the same beetle-larva Dr. Patten finds further a remarkable structure, in that on the dorsal side of these eyes exist two cell-layers, the outer of which seems to be continuous with the corneal hypodermis, while the other, the cells of which are elongate and rod-like, appears to be continuous with the retinal layer of the adjacent ocellus. These points, taken in connection with the facts that this extra-ocellar structure early becomes pigmented, and also receives a distinct nerve-supply, leads Dr. Patten to the view that this is but a dorsal extension of the true ocellus, and as pointing the way to the mode of division of the simple into the compound eye. The paper closes with some observations on the eyes of Phalangium.

Mr. F. E. Beddard, in the *Annals and Magazine of Natural History* for September, 1887, has a "Note on a New Type of Compound Eye," which he finds in Serolis and several species of Cymothoidæ, and which he regards as supporting Grenacher's rather than Patten's interpretations of some of the structures of the arthropod visual organs. The crystalline cone is secreted by two vitrella cells, and these have nothing to do with the secretion of the rhabdom of Grenacher (the pedicel of Patten). Below these vitrella cells come four elongate retinula cells, and between these are two large spherical transparent cells, and these six alone are concerned in the formation of the rhabdom, the outer four embracing it only at their outer extremities. This specialization of the retinula cells is regarded as a new feature, and one which recalls Patten's molluscan eyes, and especially his interpretation of Carriere's eye of Nereis. The author incidentally makes some corrections of his former account of the eye of Serolis, in the Report of the "Challenger" Expedition.

It may be stated, in conclusion, that American students promise to increase the literature of the arthropod eye to a considerable extent, as work is now being conducted upon the eyes of Limulus, Scorpions, Alpheus, Gammarus, and Trilobites, and possibly other forms.

Argiope riparia *var.* **multiconcha.**—For the past two years I have been studying an *Argiope*, which has sufficiently marked characteristics to entitle it to the rank of a variety of *A. riparia*, if not to a distinct species. The female is larger than any specimen I have seen of *A. riparia*, and she makes a group of cocoons, usually four, sometimes five, which she hangs in a cluster by the side of her snare, in the midst of an abundance of bright yellow, flossy silk. The cocoons are fashioned like those of *A. riparia*, and are about the same size. In honor of these multiple cocoons I call the spider *Argiope riparia* var. *multiconcha*.

Female 23 mm. long, first legs 33 mm. in length. The cephalothorax is about 9 mm. long, and nearly as wide as it is long, and covered with white hairs close up to the eyes. The two first legs are black, and the rest have the femora a deep orange-color. The abdomen is oval, and on the front is a sharp-pointed hump at each corner. The back of the abdomen is black interspersed with deep orange, darker than that of *A. riparia*, and the color is more irregular in outline than in riparia.

The under side of the body is colored and marked like *A. riparia*, and the epigynum is covered in the same way by a long black process.

The young look very different from the adult spider. Before the last moult there are five transverse bands of white and brown on the back of the abdomen. All of the legs are annulated with white and gray.

This spider lives in Guthrie, Missouri, and probably in other places. It frequents more sheltered places than our *A. riparia*. It likes to make its home under the roof of a piazza, and sometimes gets into houses, where, if undisturbed, it will hang its cocoons. I have a set of four cocoons that were made in a kitchen where a great cooking-stove was in almost constant use to supply the demands of a large family.—*Mary Treat.*

The Migration of the American Magpie to Eastern Nebraska, Twenty-five Years ago.—In Goss's "Birds of Kansas," 1886, p. 35, the magpie (*P. hudsonica*) is mentioned as "an occasional fall and winter visitant in Western Kansas," no mention being made of the magpie in Eastern Kansas. Dr. Aughey, in his list of "Birds of Nebraska," 1880, says "the magpie exists in Western and Northern Nebraska." Dr. L. E. Hicks, State University, in a private letter, dated November 4, 1887, says, "I have not seen the magpie in Eastern Nebraska, and only one in the western part: in Dawes County, last month. I have reliable information of a pair nesting near Grand Island. They undoubtedly breed in Nebraska."

Hence it is safe to conclude that the magpie (1887) is rather a rare bird in Eastern Nebraska, and most especially in the southeastern portion of the State. Such was not the case twenty or

thirty years ago. In questioning the early settlers about the birds of Southeastern Nebraska, between 1850–65, the magpie is usually the first bird mentioned. I am told by a dozen or more reliable persons that it was a greater pest than the common crow: pecking holes in the backs of fat hogs, eating off the tips of their ears, etc. They were very numerous in the fall and winter; one reliable witness stating that, about twenty years ago, he put out poison for the wolves, and on going to the spot the next morning found no less than forty dead magpies. The "Birds of North America in Smithsonian Institution," published in 1860, gives descriptions of twenty magpies killed in 1856, at various points on the Missouri from central Eastern Nebraska to the Black Hills.

I am fully satisfied that twenty or thirty years ago the magpie (*P. hudsonica*) made its annual fall and winter visit to the Missouri River bottoms, extending from Southeast Dakota to the Kansas State line, some few breeding in this section.—*W. Edgar Taylor, State Normal, Peru, Neb.*

Missouri River Crow-Roosts.—In vol. xx. p. 780, AMERICAN NATURALIST, it is stated that "the number of crows in the Western States, comparatively speaking, are so insignificant that their roosting-places have not been noticed by the ordinary observer." Probably the writer did not aim to include the Missouri Valley, yet such a conclusion seems to be general, but, undoubtedly, is incorrect.

A large roost of *C. americanus*, covering perhaps four or five acres, exists on Hogthief Island, in the Missouri River, about six miles above Peru, Neb., and fifteen miles below Nebraska City. Two other good-sized roosts are known, one ten miles north, and the other on an island eight miles south of Hogthief Island. Mr. N. S. Goss, author of "Kansas Birds," in a letter written October 29, 1887, says, "The crows had, several years ago, quite a large roost in a heavily-timbered bend on the Neosho River, in Allen County (Kansas), and I am informed that there is a roost on the Wakarusa River, in Douglas County, and without doubt there are several others in the State."

I am informed of several smaller roosts in Eastern Kansas and Southeastern Nebraska, but perhaps the greater number roost on Hogthief Island and contiguous territory. All the principal roosts, numbering, perhaps, not less than one hundred thousand crows, are in an almost direct north and south line not over one hundred and fifty miles in length. I am of the opinion that more than half of the above number roost on Hogthief Island and adjacent territory. The crows have been roosting on and near this island for at least twenty-five years, beyond which time, owing to the new settlement of the country, I have not, so far, been able to trace their history. Probably, at some time previous

to the settlement of the country, the crows at these various roosting-places in Eastern Kansas and Southeastern Nebraska had one roost,—different roosts being formed by the change of food-supply occasioned by the settlement of the country.

The crows assemble on the island named about the first of October and disperse about the first of May. About daybreak on a fine morning, when setting out for the day's journey, their chatter and noise, made in taking flight, may be distinctly heard in Peru, six miles away. A reliable witness, who has lived in the country for some ten or fifteen years, states that he has often "observed, flying in one direction, flocks of crows six miles long and one-half mile wide." In the winter the crows are so very plentiful in the surrounding country, including a radius of from twenty to forty miles, as to attract the attention of the most careless observer. Farmers have very often been compelled to guard their feed-pens. I have frequently been told by reliable persons that the crows in severe winters peck holes in the backs of hogs, in some cases eating off the ears.

Sometimes these crows roost in small bushes and large weeds, but generally in trees, often the willow or cotton-wood.

I am aware that many of these crows breed in this territory; this fact having been proven by Messrs. C. J. Pierson and J. M. Root, of the Normal Science Society, and by Mr. Goss and Professor Cragin, of Kansas. But it seems probable that some, at least, go to other territories for breeding; as several students living in Furnas, Hall, and other counties in Central Nebraska have noticed that in the summer and winter crows are very seldom seen, while large flying flocks are commonly observed in the spring and fall. However, we hope to investigate this point further, as well as determine something more definite as to numbers, former roosts, and mode of life.

The roost on the island may be plainly seen from the tower on the Normal School building.—*W. Edgar Taylor, State Normal, Peru, Neb.*

A Mink gnaws Iron Wire.—We have been troubled by minks in the trout-ponds and among the wild fowl in the water set apart for them. Six steel traps yielded four minks in three nights; two of these were caught by the fore leg and uninjured. A box was fitted with a partition, and the top of it covered with galvanized iron netting, one-inch mesh, such as is sold for poultry-yards. The first night they kept quiet, but the following one the large male gnawed a hole in the wire big enough to get his head through, and the wires cut his throat, so that he was dead in the morning. The female cut the wire sufficiently to get through, and was found loose in the room next morning. At present writing she is alive in the National Museum, where she was sent at the request of Prof. G. Brown Goode. I have kept

live minks with heavier wire-cloth, of smaller mesh, but never imagined that they could cut poultry netting.—*Fred. Mather, Cold Spring Harbor, N. Y.*

Fauna of Beaufort, N. C.—Beaufort has long been a favorite locality for zoological collectors, and the recent establishment there of the marine laboratory of the Johns Hopkins University has brought it into greater prominence. A recent number of the *Studies* of the university contains four papers on the fauna of the locality. Dr. McMurrich catalogues nine species of sea-anemones, *Sagartia pustulata* and *S. gracillima* being new. The molluscs of the region are enumerated by Dr. H. L. Osborn. His list is confessedly incomplete, but sixty-one species being enumerated outside of the group of Opisthobranchs, where the forms were not identified. Professor Nachtrieb, in his account of the ten species of echinoderms, gives considerable information of value, in that he mentions the probable or ascertained times of spawning of each species. Prof. O. P. Jenkins enumerates one hundred and thirty-four species in his list of fishes, of which twenty-three are not included in any previous catalogue of the fish-fauna of the locality.

The Pug-Dog and the Chihuahua Dog.—Two crania of pug-dogs which I have recently examined display identical dental characters, and show that the species cannot be referred to the genus Canis, but to the nearly allied form Synagodus Cope.[1] This genus differs from Canis in the presence of but two inferior true molars (one sectorial and one tubercular), and in the absence of the internal cusp from the inferior sectorial. The species may be called *Synagodus retusus*. It differs from *S. mansuetus* Cope, the type of the genus, in its excessively abbreviated muzzle and in the possession of two roots to the inferior tubercular tooth instead of one.

The Chihuahua, or naked Mexican dog, is the *Canis gibbus* of Hernandez,[2] and Pellone of the Mexicans. I have examined the dentitions of three specimens of this dog, and Professor Dugés has described and figured that of a fourth. In none of them is the second inferior molar present, and the internal cusp of the inferior sectorial is wanting in all. In other points the dentition is somewhat variable. The premolars are $\frac{2}{3}$ or $\frac{3}{3}$, and the true molars $\frac{0}{2}$, $\frac{1}{2}$, and $\frac{2}{2}$. In the specimen with three superior premolars the first two are rudimental. As the premolars are $\frac{4}{4}$ in Synagodus, the characters of the *C. gibbus* place it in the genus Dysodus Cope, where the premolars vary from $\frac{3}{3}$ to

[1] Proceedings Academy, Philadelphia, 1879, p. 186.

[2] See Dr. A. Dugés, Naturaleza, Mexico, 1880 (1882), p. 14, for an article on this dog.

$\frac{2}{2}$,[1] and where the second superior true molar is wanting. But one specimen of the *C. gibbus* possessed the second superior true molar. The species may be called *Dysodus gibbus*. It differs from the Japanese spaniel (*D. pravus* Cope) in its elongate muzzle, and in the great sparseness or absence of hair, in its erect ears, and in various other respects.

The characters of these genera are as well marked as those of non-domesticated forms of Canidæ. The deficiencies of dentition, although concomitants of reduced size, are not caused by it, since a majority of the extinct Canidæ, which preserve with great constancy the characters wanting in Synagodus and Dysodus, are of equal and smaller size.

I have had a female Japanese spaniel in my possession for eight years, and she has had pups several times. With one exception they never lived to be more than a few months old, and were of very erratic mental constitution. They displayed a great deal of ferocity in their family relations, nearly killing each other on several occasions. They nearly all died of convulsions.—*E. D. Cope.*

EMBRYOLOGY.[2]

The Rudimentary Pineal Eye of Chelonians.—In the *Quar. Jour. of Micr. Sci.* for October, 1886, W. Baldwin Spencer describes very fully the presence and structure of the pineal eye in Lacertilia, but makes no mention of its occurrence in any of the Chelonia. The other day, while looking over some sections prepared by the writer from an embryo of *Chrysemys picta*, presented by Dr. C. S. Dolley, Prof. J. A. Ryder called my attention to an organ which he took to be the pineal eye. Subsequent investigation showed this to be the case.

The embryo first cut was one measuring three-quarters of an inch from the tip of its nose to the end of the tail. The sections were made in a vertical longitudinal direction, and in the median line the structure referred to was found. The pineal outgrowth lies just behind the fore-brain; the proximal part of its stalk is tubular, while the distal end is flattened from above. It curves towards the tip of the snout, and its lower surface faces the inner margins of the cerebral hemispheres.

The eye occurs as a hollow vertical evagination from the upper surface of the pineal outgrowth, and leaves the stalk of the latter at the beginning of its distal fourth, measuring from its rear end. The two together, the eye and the pineal body, resemble very much in longisection the outline, as seen from the side, of the hammer of a gun.

[1] Naturalist, 1881, p. 233, where the dental characters of eight specimens are described.

[2] Edited by JOHN A. RYDER, Ph.D., Biological Department, University of Pennsylvania, Philadelphia.

Approaching the eye from without inward, one finds first the epidermis of the skin, then the corium, then a few irregularly-branched connective-tissue cells, the pia, and, finally, the outer surface of the eye. Surrounding it like a collar is a blood-sinus, which even after two or three years' preservation in alcohol was still filled with corpuscles, whose nuclei came out very sharply on staining in borax carmine.

The cells composing the eye are distinctly columnar throughout, with well-marked nuclei. The eye is balloon-shaped, or pyriform, and the cells on the upper half point towards the centre, while the remainder point towards the long axis of its short stalk. There is some fine thread-like or stringy material in the cavity of the eye which does not take the stain, and which is probably the coagulated remains of some serum or plasma which filled the cavity.

On looking at the upper surface of the head in other unstained, alcoholic, specimens of *Chrysemys picta*, there is no external evidence of the presence of this unpaired organ. In fact, the pineal eye in this type is evidently in a rudimentary condition; possibly in process of degeneration. No part of the outer wall of the optic vesicle of the pineal eye shows evidence of thickening into a lens, such as is found in that situation in many Lacertilia. It approximates, with its hollow stalk, somewhat towards the condition of *Cyclodus*, as described by Spencer, but there is no pigment developed anywhere in the pineal eye of *Chrysemys*.

However, in one specimen of unhatched *Cinosternum pennsylvanicum*, which, through Professor Ryder's kindness, I have had the privilege of examining, there is seen in the median line, half-way between the snout and the front end of the carapax, a clearly defined brownish pigment-spot. Judging from analogy and comparing my results with those of Mr. Spencer, we may expect to find the eye in this species much more highly developed than is the case in *Chrysemys* described above.

These observations are also of greater interest because of the fact that none of the Chelonians, in the adult condition, as far as I am aware, have a parietal foramen developed, such as is found in many Lacertilians. It is therefore clear that the pineal eye in Chelonians cannot at any time during life attain to even the functional importance of that organ in any of the Lizards in which it has hitherto been observed.—*George Fetterolf, Biological Laboratory, University of Pennsylvania*, November 9, 1887.

PSYCHOLOGY.

The Theology of Evolution.[1]—In the pamphlet bearing the above title is contained a statement of the evidence in favor of primitive and creative mind in nature, brought to light by the

[1] The Theology of Evolution, a lecture, by E. D. Cope; A Review of the Theology of Evolution, a reply to Dr. Montgomery, by E. D. Cope; The Relation of Mind to Matter, by E. D. Cope; all, 1887, Philadelphia, Arnold and Company.

doctrine of evolution. Its theses may be stated as follows: *First.* The mind of animals and men exercises a directive, though not a creative, power over their movements. This directive power is an evident direction of the course of energy by consciousness, and is, as such, a direct interference with mechanical process. *Second.* Since the evolution of animal types is due to their movements within their environment, and the movements have been inaugurated in conscious states by the directive power of will (*not* free will), the evolution of organic types is due to mind. *Third.* Since protoplasm is sustained as a chemical body against the ordinary chemical forces by the presence of vitality or some of its class of energies, the origin of protoplasm cannot be due to chemical energy, but to some energy of the vital type. This third thesis should be modified so as to read: Since protoplasm is decomposed as a chemical body by the attacks of living micro-organisms only, at ordinary temperatures, it is evident that vital energy possesses a direct control over the chemical energy. And vital energies are believed to possess no peculiarity by which they may be distinguished from the non-vital, excepting the stamp of a pre-existent or present consciousness.

From these premises it is inferred that there is and has been a primitive mind as an attribute or property of primitive matter. And this mind directs energy profitably to conscious beings and produces advantageous types of automatic energy by cryptopnoy. It thus acts as a building and creating agency, opposing the chemical and physical forces, whose outcome is destruction only, or the "dissipation of energy and the integration of matter."

In the second of the brochures referred to, the articles of the "Theology of Evolution" are stated as follows (p. 28):

"I. Nothing exists excepting tridimensional matter and its properties (or behavior).

"II. The properties of matter are energy (motion) and consciousness.

"III. Consciousness is not a property of universal matter, but is conditioned by the axiomatic qualities of matter, as extension and resistance.

"IV. The mode of motion (energy) of matter is, on the other hand, primitively conditioned by consciousness, but ceases to be so conditioned when it reaches a certain degree of automatism (to be better defined by future research).

"V. Consciousness ultimately disappears from matter and energy which have established automatic conditions; therefore the condition of the persistence of consciousness is the maintenance of will, the antagonist of mechanical automatism.

"VI. Every new process of conscious will creates new (? molecular) machinery in the conscious matter.

"VII. Hence physical and mental development depend on the will.

"VIII. The phylogeny of protoplasm requires a parent substance.

"IX. Since, then, the existence of primitive mind in a primitive physical basis is far more probable than the opposite view, the existence of a Supreme Being is exceedingly probable.

"X. Since will controls the movements and organization of matter, the persistence of human consciousness in other worlds than the earth is possible."

Dr. Edmund Montgomery combats these views in a series of nine articles, published in the *Open Court*, of Chicago, under the heads "Cope's Theology of Evolution" and "Are we the Products of Mind?" He asserts with regard to the theses of Cope's first pamphlet: *first*, that mind does not, because it cannot, control or direct the movements of matter; *second*, that consciousness is not the director of the evolution of living beings; *third*, that "primitive mind in primitive matter" would be of the lowest grade of mind from lack of organization, and could only represent a Deity inferior to man and many of the animals.

Dr. Montgomery also holds that mind is not a property of matter, and further takes the idealistic position in metaphysics that "matter is only a superfluous impediment easily argued away." But at the same time he holds the very distinct and apparently inconsistent opinion that mind can only exist in connection with highly organized protoplasm. His denial that mind can control matter is absolute, and he substitutes for this opinion a theory of "special hypermechanical energies" not yet formulated. The objections of Dr. Montgomery are replied to by Professor Cope in the second and third brochures referred to, and in a fourth in the *Open Court*, of Chicago, entitled "Idealism and Evolution."—*E. D. Cope.*

An Expression of Animal Sympathy.—While riding along a country road in the environs of Cincinnati, Ohio, about the 1st of last October, I noticed a remarkable and very amusing display of animal intelligence. In a field beneath some trees at the bottom of a very high hill stood facing each other a donkey and a young bull. The bull was standing very patiently, slightly nodding his head up and down, while the donkey, with a rather heavy stick about two feet long in his mouth, was scratching his companion's forehead. We stopped our horse and watched the operation for some time. Once the donkey dropped his instrument, but, without hesitation, lowered his head, picked up the club again with his teeth, and continued scratching very gravely, to the evident satisfaction of the bull. We often see two cows "rubbing horns," and whether this was a return for a similar favor from the bull or not, the donkey very clearly realized his poverty in the matter of horns, and happily supplied the deficiency.—*Charles L. Edwards.*

MICROSCOPY.[1]

Method of Photographing Serial Sections.—The development of microtomical technique has made it a comparatively easy matter to produce great numbers of fine sections in a very short time. As the sections with which an anatomist or an embryologist has to deal are generally too small for macroscopical examination, it is often difficult to obtain an outlook over the material accumulated. The microscopical examination of hundreds or thousands of serial sections, if only for the purpose of general orientation, is a slow and tedious work. One cannot carry the picture of the series along while examining the sections, one by one, with the microscope. This can only be accomplished indirectly, through representations enlarged just enough to make it easy to examine them macroscopically. To make outline sketches of the whole series, or at least of the more important portions of it, calls for an enormous sacrifice of time, together with a large amount of most fatiguing mechanical labor. Much more satisfactory results may be obtained by the aid of photography, and with relatively little expenditure of time and energy.

Professor His,[2] of Leipzig, to whom we are indebted for the "embryograph" and a method of "plastic reconstruction," previously described in this journal, employs the apparatus seen in the accompanying cut for photographing serial sections.

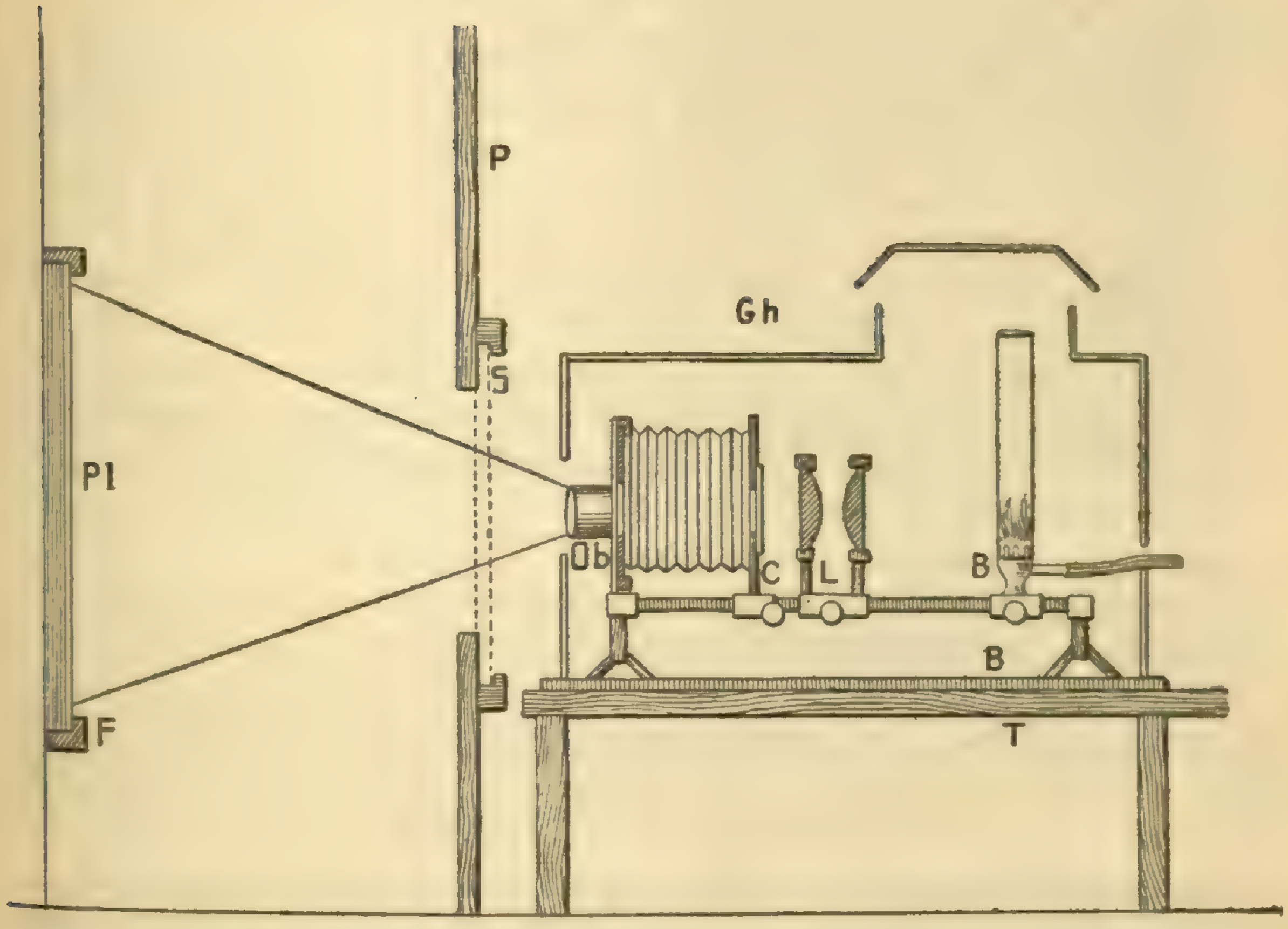
The objective (Ob) is a Steinheil *antiplanatic* of 12 cm. focal distance, or an *aplanatic* of the same factory of 14 cm. focal distance. The latter gives a little less light than the former, but possesses the advantage of an accurate and uniformly-sharp definition.

For embryos that are not exceptionally small, a magnification of ten to fifteen diameters generally suffices. With any magnification not exceeding twenty diameters all the sections mounted under a cover-glass 3 cm. square can be reproduced at the same time. Long series of sections can thus be photographed in a short time, and the material so obtained is invaluable, not only as a means of general orientation, but also as a reliable basis for "plastic reconstruction" of every kind.

The projection-apparatus consists of a horizontal rack carrying at the anterior end a plate with the photographic objective (Ob); behind this a second plate (C) (with a central perforation), connected with the first by a bellows, and serving as a carrier for the object-slide; then a double condenser (L) 11.5 cm. in diameter, with a focal distance of 8 cm.; and, behind all, an argand gas-burner (B).

[1] Edited by C. O. WHITMAN, Ph.D., Milwaukee, Wisconsin.

[2] W. His, "Ueber das Photographiren von Schnittreihen;" Arch. f. Anat. u. Phys., Anat. Abth., 1887, 2d and 3d Heft, p. 174.



The rack bearing all these parts has two feet resting on a base-board (B), which can slide forward or backward between guides on the table (T). The coarse adjustment is effected, first of all, through this sliding movement of the base, and then by a screw-movement of the object-carrier (C). The fine adjustment is made by turning the objective, which works in a fine screw. Extraneous light is excluded by inclosing the whole apparatus in a tin box (Gh) provided with a wide side-door.

The size and distance of the picture vary within relatively large dimensions, so that an ordinary photographic camera could not conveniently be employed. The arrangement is such that the picture is projected upon the wall of the dark-room, in front of the objective, instead of a ground-glass behind it, as in the ordinary camera.

The dark-room is divided by a partition (P), which is provided with a door and a sliding screen (S). On the wall opposite the screen is fixed a large frame (F), which carries a glass plate (Pl). The image is first brought to a focus on a sheet of white paper behind the glass plate; and then, after closing the screen, the white paper is replaced by the photographic paper.

The photographic paper, known as the "Eastman bromide-of-silver paper," is sensitive enough for use with lamp-light, and the manipulations are extremely simple.

The time of exposure varies according to the magnification and the diaphragm employed. With the Steinheil aplanatic and diaphragm (4) an amplification of ten diameters requires an ex-

posure of six to eight minutes. Very thin, transparent sections require less time than thick or deeply-stained ones.

The pictures are, of course, negative, but they are none the less valuable for the purposes before named. If positive pictures are desired these are easily obtained, as the photographic paper is sufficiently transparent to admit of copying. For this purpose lamp-light is better than sunlight, and an exposure of one-half to one minute is sufficient. Both the negative pictures and the positive copies admit of further finish with pencil or color.

Full details of manipulation are furnished with each package of the Eastman paper. The operations which follow exposure are (1) softening of the paper in water; (2) development of the picture by means of potassium oxalate and ferrous sulphate; (3) washing in acidified water; (4) fixation through hyposulphite of sodium; (5) washing and drying.

SCIENTIFIC NEWS.

—In the November number of the AMERICAN NATURALIST Mr. J. F. James kindly calls my attention and that of the general public to what seems to be a slight put upon his work. A word of explanation seems to be due both to Mr. James and myself. The object of the paper entitled "Origin of the Indiana Flora" was simply to apply well-known facts with regard to the North American flora to the specific case of Indiana. In order to do this it seemed necessary to give an introduction containing an explanation of the general problem for those for whom the writing was intended,—a thing that would not have been necessary for the scientific public. My former assistant, Mr. Thomson, was asked to look up the literature of the subject and prepare as compact a statement as possible of the known facts. I suppose that he found Mr. James's paper useful, as being the most concise compilation of facts so well known as to have become general property. That due credit was not given to Mr. James for this assistance was a great oversight, but that it could not have been intentional appears in the very extracts that Mr. James has culled out. He is there mentioned by his full name as an authority for some statement or other. I am blameworthy for not more closely inspecting this part of the work, but, as the chief trouble was failure to give full credit to Mr. James, it is hereby done, with an expression of regret that the omission was not seen in time to remedy it.—*John M. Coulter.*

—The Imperial University of Japan has recently established a marine biological station at Misaki, a day's journey from Tokio, an account of which has recently been published by Professor Milsukuri in vol. i. of the *Journal of the College of Science* of the

university. The building is of wood; the laboratory-room is forty-eight feet long by from twelve to eighteen in width, and affords space for about ten workers. Besides this there is a room for sorting specimens and another for library purposes, while the second story affords sleeping-rooms. Salt water runs to the tanks and aquaria in the laboratory. Misaki is favorably situated for biological investigation, and the catalogue of fauna outlined by Professor Mitsikuri is tantalizing. Foraminifera, Radiolaria, glass sponges (Hyalonema and Tetilla), corals, and Pennatulids, a Pentacrinus "two or three feet long," Chiton, Haliotis, Doliolum, pteropods and heteropods, Actinotrocha, Tornaria, Pilidium, etc., characterize the general facies of the locality when viewed from the zoological side.

—Dr. G. H. Sternberg, U. S. A., has just returned from Havana. He was sent by the U. S. Health Commission to examine the claims of the various methods reported by physicians in Rio Janeiro, Vera Cruz, and Havana for combating yellow fever by inoculation. The discovery of the supposed yellow-fever bacilli has been followed by attenuation cultures, after the method of Pasteur. Dr. Sternberg has brought with him culture series of these bacilli from all these localities, and will proceed to develop them and test their merits as preventives of this dread scourge of the tropics.

—Prof. Alfred Giard, of Lille, has been called to Paris as "maître de conférences à l'Ecole normale supérieure."

—Dr. O. S. Jensen, who had just published a valuable paper on "Spermagenesis in Mammals, Birds, and Batrachia," died in Christiania, September 14, 1887, aged forty years. He was a skilful anatomist.

—Professor Hugo Lojka, of Buda-Pest, a student of lichens, died September 7.

—In the death of Mr. Oscar Harger, which occurred at New Haven, November 6, of cerebral hemorrhage, science has lost an able and conscientious worker, whose labors are none the less important because they are not widely known. Born at Oxford, Conn., in 1843, his early years were spent upon a farm, where, while his educational facilities were very limited, he became imbued with that love of natural history to the study of which his life has been devoted. His attention was early directed to botany, a subject which he pursued with unabated zeal throughout life, and it was the success that attended his early efforts in this study that induced him, as he has told me, to prepare for college, which was accomplished largely without pecuniary aid. He graduated at Yale College in 1868 with high honors, the expenses of his course having been chiefly defrayed by his own exertions in

mathematical calculations for life-insurance companies and for Professor Newton. The two following years were spent in natural history studies in Sheffield Scientific School with Professor Verrill and his most intimate friend, Prof. S. I. Smith. In 1870 he was appointed assistant in palæontology to Professor Marsh, a position he uninterruptedly held to his death.

His life for twenty years has been wholly that of a student and investigator, but the published works by which he is known to the scientific world are not numerous or extended, though important. His chief work was a "Report on the Marine Isopoda of New England and Adjacent Waters," published in 1880, but he also published not a few other papers in the *American Journal of Science*, and elsewhere, on isopods, myriapods, and a fossil spider (Arthrolycosis) from the Coal-Measures. The real work of his life, however, will never be appreciated save by those who knew him well. A patient and accurate observer, possessed of truly remarkable logical powers, and a man of very extensive and most accurate knowledge, the results of his eighteen years' work in vertebrate palæontology have been of great value, notwithstanding the fact that none of them have been published by him. In eight years' daily intimate association with him in the Yale College Museum, I cannot recall an instance where his matured opinions and statements were assailable; errors he made, of course, but they were fewer than I have ever known in any other person. Unfortunately, his opinions, though never gainsaid, were not always followed. To my personal knowledge, nearly or quite all the descriptive portion of Professor Marsh's work on the Dinocerata was written by him, and was published without change, save verbal ones. The descriptive portion of the Odontornithes was likewise his work, but this I cannot say from personal knowledge.

Born with unsound physique, his life has been a constant struggle with difficulties that a man with a less indomitable will would have found unconquerable; that he has lived for the past eight years has been a surprise to his physicians and friends. He was firm and pronounced in his opinions, but withal of a very modest and retiring disposition. The few intimate friends that knew him cherished and respected him in a remarkable degree. He was married in 1875 to Miss Jessie Craig, of New Haven, who survives him without children.—*S. W. Williston.*

—Ferdinand V. Hayden, M.D., Ph.D., the well-known geologist, died December 22 at his residence in Philadelphia, after an illness which had confined him to his room for over a year and a half.

He was born in Westfield, Mass., September 7, 1829, and at an early age emigrated to Ohio, and was graduated from Oberlin College in 1850. He afterwards studied medicine at the Albany

Medical College, taking his degree in 1853. He did not practise medicine, but in the spring of the year of his graduation visited the "Bad Lands" of Dakota on White River in the interest of Prof. James Hall, explored one of the remarkable ancient deposits of extinct animals, and returned with a large and valuable collection of fossil vertebrates. He spent the three following years in exploring the Upper Missouri, and his large collection of fossils was partly given to the Academy of Sciences in St. Louis and a part to the Academy in Philadelphia. These collections attracted the attention of the officers of the Smithsonian Institution, and he was appointed, at the suggestion of General J. A. Logan, geologist on the staff of Lieutenant G. K. Warren, of the Topographical Engineers, who was then making reconnoissance of the Northwest, and continued on duty till 1861, when he entered the war as a surgeon of volunteers. He was brevetted lieutenant-colonel for meritorious services at its close.

In 1865 he was elected Professor of Geology and Mineralogy in the University of Pennsylvania, and held that post until 1872, when he resigned on account of the increased labor in managing the survey. In the summer of 1866 he made another expedition to the Upper Missouri.

The United States geological survey of the Territories, under charge of Professor Hayden, was commenced in the spring of 1867 and continued until 1879. Seven annual reports of the survey have been published in 8vo, and eight volumes of the quarto final report. Three volumes of the 4to series are not yet published.

His reports of the exploration of the famous Yellowstone region in 1870 and 1871 induced Congress to set apart by law as a national park three thousand five hundred and seventy-five square miles of the public domain, containing within its limits most of the geysers, hot springs, and other wonders of that region.

The United States owes to Dr. Hayden the establishment of its Geological Survey. Those acquainted with the history of this great work can testify to the energy and perseverance which he expended in accomplishing it, qualities which were in a high degree inherent in Dr. Hayden's character. Dr. Hayden's influence was only second to that of Baird in securing for science the aid and recognition which it has received from the government of the United States. And at the period of his greatest success Hayden was always the same unpretentious and enthusiastic seeker for knowledge. He was singularly free from sordid motives, and he left the service of the government a poor man. His retirement was caused by an intrigue discreditable to all who participated in it. His removal from the position which he had won through so many years of toil, was influential in bringing on the disease to which he succumbed.

Dr. Hayden left a widow but no children.

—By the death of Prof. William Stebbins Barnard, on the 13th of November, in his thirty-ninth year, American Science has lost a biological investigator and teacher of unusual ability, training, and originality.

Dr. Barnard was born at Canton, Ill., on the 28th of February, 1849. After a year at the University of Michigan, he entered Cornell University at its opening in 1868. While a student he paid special attention to Natural History, and was selected by the late Prof. Chas. Fred. Hartt to assist in his expedition to Brazil. In that country Dr. Barnard made important explorations and collections, and some of his specimens are in the museum of Cornell University. After graduating in 1871, he spent two years under the best teachers in Germany, and on taking the degree of Ph.D. at Jena, in 1873, received from Haeckel a personal certificate that in his studies he had "shown the highest degree of excellence." Returning to Cornell, he made many observations and drawings of the Protozoa, on which group he gave courses of lectures at the University, at the Anderson School on Penikese Island, in the summer of 1874, and at the summer schools in Normal and Peoria, Ill., in 1875. From 1876 to 1878 he was professor of natural science in the Oskaloosa (Iowa) Normal School, and then for two years gave at Cornell University the instruction in entomology and invertebrate zoology during the absence of Prof. J. H. Comstock as United States entomologist. Under Professor Comstock's successor he became an assistant in the entomological division of the Bureau of Agriculture, and during the following five years made valuable observations upon destructive insects, and devised several appliances for spraying insecticides upon the cotton-worm and other forms; his apparatus and experiments are described in the department reports and bulletins, and were highly commended by the chief of the division.

During the last two years he was professor of natural history in Drake University, Des Moines, Iowa, whose faculty and students at his death adopted resolutions expressing their affection, esteem, and sense of irreparable loss.

Besides his contributions to the U. S. Entomological Reports, Dr. Barnard's publications were as follows:

1. "Observations on the Membral Musculation of *Simia satyrus* (orang) and the Comparative Myology of Man and the Apes." *Amer. Asso. Proc.*, August, 1875, pp. 30, two plates.

2. "Observations on the Development of *Didelphys virginiana*" (the opossum). *Ibid.*, pp. 2, one plate.

3. "Catalogue of the Invertebrates" (excepting insects) in Ward's natural science establishment, octavo, pp. 96, eight plates. Rochester, 1876.

4. "New Rhizopods," pp. 3, one plate. *Amer. Quar. Microscopical Journal*, 1879.

5. "Zoological Education." Read before the University Convocation, July 13, 1879. Report of the Regents of the University of the State of New York, 1879, pp. 529–532.

6. "Protoplasmic Dynamics." AMER. NATURALIST, April, 1880, pp. 10, five figures. Hundreds of accurate and beautiful drawings and diagrams, with notes and manuscripts equivalent to several large volumes, bear witness to his scientific spirit and industry, and indicate what he might have put in shape for publication but for imperfect health and an almost too faithful devotion to his duties as a teacher.

In 1874, Dr. Barnard married Miss Mary Nichols, sister-in-law of Prof. B. G. Wilder. A son inherits much of his father's general ability, artistic talent, and fondness for natural history.—*B. G. W.*

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Natural Science Association of Staten Island.—October 8, 1887.—Dr. A. L. Carroll and Mr. Arthur Hollick exhibited specimens of the material from an artesian well at Bachmann's brewery, Clifton, in which the recent alleged discoveries of gold, copper, and rubies were reported. The specimens, said to have come from the lowest depth (about nine hundred feet), were typical New York Island rock, being a mica-schist containing garnets, which were probably mistaken for rubies. In this connection it is of interest to note that Dr. N. L. Britton predicted the finding of this rock below and to the eastward of our serpentine, in case a sufficient depth was reached. (*Annals of the N. Y. Acad. of Sciences*, vol. ii., Nos. 5 and 6, April 4, 1881.) The greatest interest was, however, centred in a specimen of conglomerate, consisting of pieces of wood, mortar, and scraps of iron and brass cemented together with sesquioxide of iron. It was not stated whether specimens of this material were the ones analyzed, but if they were it would not be difficult to account for the finding of copper, iron, and perhaps other metals, as it is evidently the refuse of some metal-working establishment, and is of recent formation.

Mr. Hollick exhibited drawings of lemon-pits, which had germinated while inside the lemon. One had developed two imperfect *green* cotyledons, and had pushed its way for about three-quarters of an inch through the pulp of the fruit.

A skin-scraper and several arrow-heads, from Old Place, presented by Mr. L. W. Freeman, were shown. Also a skin of the spotted warbler (*Dendræca maculosa*), obtained by Mr. R. H. Britton, at New Dorp, on May 7. The same species had been noted on May 15 in the neighborhood of Eltingville by Messrs. Wm. T. Davis and Arthur Hollick.

Mr. Jas. Raymond stated that while sailing in a cat-boat, near the Long Island shore, a fish-hawk lit on the mast-head, where it remained some time, but finally flew to the mast of a schooner lying near by. These birds visit Staten Island in early spring, but are particularly numerous in late summer and autumn. They frequent the sea-shore and ponds, and many are shot while perching on certain favorite dead trees, eating their prey. So far as known only one pair of these birds has attempted to nest on the island. The nest was in process of construction on June 14, 1874, in a partly dead chestnut-tree on the meadows near Garretson's, but the birds were frightened away before completing it. If protected from persecution there is apparently no reason why they should not nest here as freely as they do along the coast of New Jersey.

Mr. E. M. Eadie reported the capture of a walking-stick insect (*Diapheromera femorata*) at Old Place. It is of quite rare occurrence, only three other specimens having been collected by members of the Association on Staten Island within the past six years.

Boston Society of Natural History.—The first general meeting for the season was held on Wednesday evening, November 2, 1887. Prof. William M. Davis spoke of the "Physical History of the Somerville (Mass.) Slates;" Dr. W. G. Farlow discussed the "Conception of Species in Cryptogamic Botany;" and Dr. J. Walter Fewkes described a "New Mode of Life among Medusæ."

November 16.—The question of holding the general meetings once or twice a month was decided in favor of twice a month. Prof. A. Hyatt spoke of the values in classification of the stages of growth and decline, and propositions for a new nomenclature. Mr. S. H. Scudder described the means employed by the butterflies of the genus Basilarchia for the perpetuation of the species. Prof. Wm. T. Sedgwick spoke of the new American *Journal of Morphology* and the "Lake Laboratory of Biology at Milwaukee."

Biological Society of Washington.—The one hundred and sixteenth regular meeting was held on Saturday evening, December 3, 1887, in the Assembly Hall of the Cosmos Club. The following communications were read: Mr. Charles Hallock, "The Great Roseau Swamp;" Dr. C. A. White, "On the Rapid Disappearance of the Cast Antlers of the Cervidæ;" Dr. Theobald Smith, "Peptonizing Ferments among Bacteria;" Mr. C. D. Walcott, "A Fossil Lingula preserving the Cast of the Peduncle;" Dr. Theo. Gill, "The Phylogeny of the Cetacea."

INDEX TO VOL. XXI.

Abbott, Helen C. De S., comparative chemistry of higher and lower plants, 719, 800.
Acanthocephala, 187.
Acanthosoma, 183.
Acanthrometra, 17.
Aceratherium, 1004.
Achromatin, 150.
Acineta, 19.
Actinistia, 1017.
Actinobolus, 19.
Actinopterygia, 1017.
Actinosphærium, 16, 139.
Æchmophorus occidentalis, 291.
Aëtosaurus, 468.
Afghanistan, 363, 561.
Africa, East, 361.
  Eastern, 560.
  Equatorial, 361.
  The Makua, 651.
African notes, 362.
Agassiz, Alexander, 303.
Agassiz Glacier, 361.
Age of Niagara River, 269.
Alaska glaciers, 651.
Alaskan exploration, 61.
Albite, 1114.
Albuminized felt tablets for mounting anatomical preparations, 866.
Alexanders, 51.
Alkekengi, 53.
Allium schœnoprasum L., 827.
Alpheus, development of, 288.
Alth, A. von, 106.
Amblystoma, 87.
America, 650.
American Association at New York, 833.
  Committee of the International Congress of Geologists, 835.
  Committee of the International Geological Congress, notes on classification and nomenclature, 693.
  cress, 56.
  Naturalist, 163.
  notes, 558.
  Ornithologists' Union, The, 1046.
  Rhynchocephalia, 467.
Amœba, 17, 18.
Amphibian egg, preparing, 595.
Amphiblastula theory, 347.
Amphipnous, 190.
Amphipods, mimicry in, 185.
Amyzon beds, 454.
Anabas, 190.
Anaphase, 142.
Anatomy of the auks, 777.
Anchilophus, 1067.
Anchippus, 1067.
Anchitherium, 1067.
Andesites, 275.
Andrews, E. A., apparatus for orientation in imbedding, 101.
Androctonus, embryology of, 201.
Anethum graveolens L., 911.
Angelica, 57.
Animal sympathy, an expression of, 1129.
Anise, 58.
Annisquam Laboratory, 405, 601.
Anodon, 21.
  spermatozoa, 21.
Anorthete, 275.
Antedon, 289.
Antherozoöids, 21.
Anthrax, 5.
Ants and aphids, 382, 579.
  and colored light, 383.
  and sunflowers, 295.
Apatite, 1025.
Aphelops, 1004.
Appalachians, the materials of, 956.
Aracacha, 125.
Arachnida, notes on, 194, 393.
  development of, 294.
Araujia albens as a moth-trap, 501.
Arctic explorations of Franz Boas, 206.
Arctium, 442.
Areschong, J. E., the Swedish botanist, death, 790.
Argiope riparia var. multiconcha, 1122.
Argulus and mortality of fishes, 188.
Arion, 19, 20, 219.
Ariopsis, 183.
Arkansas, survey of, 685.
Armadilloes, gestation of, 95.
Arrow-release among the Navajos, 784.
Arthropod eyes, 1120.
  eyes, preparation of, 401.
  organ of smell in, 182.
Artichoke, 126.
Artificial parthenogenesis, 484.
Artiodactyla, 985.
Ascaris, 20, 144.
  spermatozoon, 23.
Asclepias cornuti, 608.
  incarnata, 615.
Asellus, 183.
Ashburner, William, 686.
Ash-rust again, 666.
Asia, the Saraswati, 652.
Asiatic notes, 363, 561.
Asparagus, 129, 132.
Aspidorhynchidæ, 1019.
Astacus, 140.
  spermatozoon, 23.
Asteracanthion, 21.
Atelodus, 1004.
Athrodon, 1020.
Atkinson, George F., observations on the female form of Phengodes laticellis Horn, 853.
  phosphorescence in an earth-worm, 773.
  singular adaptation in nest-making by an ant, 770.
Atometric, 375.
Audubon, the proposed monument to, 1033.
Auld, R. C., hornless ruminants, 730, 885, 1076.
Aulostomum, 221.
Australia, 62.
Australian rabbit in America, 265.
  spinage, 321.

Bacteria, classification of, 78.
  in arthropods, 383.
  parasitic, 1.
Bailey, L. H., origin of the tomato from a morphological stand-point, 573.
Baird, Spencer F., death of, 836.
Balanoglossus, 391.
  larvæ, 669.
Balm, 321.

Balsamita vulgaris Willd., 903.
Barbarea, 56.
Barite, 1114.
Barnacle, 488.
Barnard, Wm. Stebbins, death, 1134.
Barneville, Henri Brisout de, 953.
Barth, 375.
Basella, 322.
Basil, 324.
Basin of the Connecticut, 938.
Batrachia and reptiles of Central America and Mexico, 1012.
notes on, 489, 585, 861.
of Brazil, 388.
teratology, 1034.
Batrachian oviposition, 310.
Baum, J. C., intelligence of a rat, 295.
Baur, G., on mineralogy, 571.
morphogeny of carapace of Testudinata, 89.
morphology and origin of the Ichthyopterygia, 837.
morphology of ribs, 942.
Beachler, Chas. S., crinoid beds at Crawfordsville, Indiana, 1106.
Beal, W. J., experiments with Lima beans in germination, 576.
Beal's Grasses of North America, 647.
Bean, asparagus, 132.
yard long, 132.
Beans, 327.
in germination, 576.
Beard, J., origin of segmental duct in elasmobranchs, 1037.
Beaumontite, 1025.
Becher, Edward, 494.
Beddard, F. E., note on a new type of compound eye, 1125.
Beet, 433.
Chilian, 708.
sea, 706.
silver leaf, 707.
white, or common, 707.
Beetle, leg of, with pollinia, 611.
Belly River epoch, 171.
Benincasa, 437.
Benton group, 448.
Berg, Carl, 303.
Bergeron, hyperite in Carboniferous of Aveyron, 1112.
Bert, Paul, 106.
Berthold, G., ordinary professor of botany at Göttingen, 953.
Beryl, 1025.
Bessey, Chas. E., a duty of botanists, 767.
Beal's Grasses of North America, 647.
botanical manuals for students, 376
eastward extension of Pinus ponderosa, 928.
growth of Tulostoma mammosum, 665.
Hepaticæ Americanæ, 1104.
iron-wood tree in Black Hills, 929.
notice of Ellis and Everhart's N. A. Fungi, 379.
notice of Hay's Economic Fungology, 552.
notice of Strasburger and Hillhouse's Practical Botany, 357.
notice of Trouessart's Microbes, Ferments, and Moulds, 551.
review of Vine's Physiology of Plants, 266.
students as collectors, 477.
the element of time in botanical study, 768.
the National Herbarium, 766.
the study of lichens, 666
the study of plant diseases, 276.
tumble-weed, 929.
westward extension of the black walnut, 929.
Wolle's Fresh-water Algæ of the U. S., 923.
Beta, 433
Bicidium, 582.
Biological instruction, 59.
Society of Washington, 688.
Biology in universities, 507.
Birds, 92, 394, 488, 585, 861, 946.
of India, 188.
roosting in town, 939.
Bismutho-sphærite, 1023.
Bite of cobra, 394.
Blastoids of British Museum, 69.
Blatta, spermatozoon, 23.
Blind animals, origin of, 82.
Blite, 437.
Blitum, 437.
Bluefish, parasite of, 195.
Boas, 206.
Bollman, C. H., new N. A. myriapods, 81, 946.
Bombinator, 489.
spermatozoa, 22.
Bombs, volcanic, 271.
Boott, William, death, 954.
Borage, 438.
Borneo, 63.
Bos, spermatozoa, 21.
Botanical estrays, 572.
journals, 74.
manuals for students, 376.
news, 381, 667, 930.
study, the element of time in, 768.
Botanists, a duty of, 767.
Botany, Practical, Strasburger and Hillhouse's, 357.
in the A. A. A. Science, 930.
Bothriolepididæ, 1019.
Boulders of decomposition, 366.
Boulenger, G. A., Reptilia and Batrachia, 673.
Bourne, A. G., account of some Indian earthworms, 860.
worms, 779.
Brain, heaviest, 389.
of Ceratodus, 544.
Branal, Karl, director of Zoological Institute of the University of Kiel, 953.
Branchiobdella, spermatozoa, 22.
Branco, W., professor of geology, University of Königsberg, 790.
Branner, J. C., appointed director of the geological survey of Arkansas, 686.
Brassica, 438, 520.
chinensis, 826.
Braunite, 374, 1114.
Brazilian Reptilia, 388.
Brennan, G. A., deities of the Navajos, 206.
Bridger group, 454.
Britton, R. H., skin of spotted warbler, 1137.
Bronn's Klassen und Ordnungen des Thierreichs, 685.
Broome, C. E., 302.
Brown-Séquard, 495.
Bruce, A. T., 405.
fellowship in biology, Johns Hopkins University, 790.
Brussels-sprouts, 440.
Bucksthorn plantain, 442.
Bunias, 442.
Burdock, 442.
Burmah, zoology of, 189.
Burmeister, H., 303.
Burnet, 443.
Bush, George, 106.
Bustonite, 374.

Cabbage, 520.
Chinese, 826.
Cactus, 354.
Caddis fly's emergence from water, 480.
Cænopodidæ, 992.
Cænozoic of North America, 445, 451.
Calcarina, 16.
Call, R. Ellsworth, food of Amblystoma mexicana, 776.
on Ctenidium of Unio aberti Conrad, 857.
Calotropis gigantea, 615.
Cambrian of Sardinia, 659.
Canis gibbus, 1125.
Cape gooseberry, 55.
Capers, 523.
Capparis, 523.
Caraway, 524.
Carboniferous genus Stereosternum, the, 1109.
Carchesium, 19.

Cardamine pratensis, L., 905.
Cardoon, 126, 525.
Carettochelys, 585.
Carey's journey, 653.
Cariacus columbianus, teratology of the antlers of, 1034.
Carnivora, development of, 394.
Carphosiderite, 472.
Carroll, A. L., garnets from artesian well, 1137.
Carrot, 527.
Carterius, 1119.
Carum, 524.
Cassino, S. E., 494.
Cassiopeia, spermatozoa, 22.
Cassiterite, 1022.
Casuarius, 585.
Caterpillars, 701.
Cathrein describes grassularite crystals, 1113.
Catnip, 701.
Caton, J. D., origin of a small race of turkeys, 350.
Caucasus, 62.
Caudisona, habits of, 211.
Cauliflower, 701.
Cave faunæ, 82.
Caves of Mentone, 370.
Celeriac, 703.
Cell, characters of, 30.
Cell-division, 145.
Cell-doctrine, 26.
Cell-plate, 148.
Cell-state, 29.
Cells, 26.
sexual, 38.
Cephalaspididæ, 1019.
Cephalopods, primitive forms, 64.
Ceratium, 17.
Ceratodus, brain of, 544.
Ceratorhinus, 189.
Cercopithecus boutourlinii, 1034.
Cerevisæ, 2.
Ceriodaphnia, 186.
Cero, parasite of, 199.
Cestoid embryos, 195.
Chænia, 17.
Chænopodium, 321.
Chætonotus, 583.
Chalicotheriidæ, 992.
Chalicotherium, 1061.
Champlain epoch, 460.
Chard, 705.
curled Swiss, 708.
Swiss, 707.
Chelonia, 143.
Chelonians, 1126.
Chemical integration, 474.
Chernil, 709.
Cherries, 583.
Cherry tomato, 55.
ground, 55.
Chicory, 711.
Chilodon, 19.
Chinese jade in America, 96.
Chirox, 566.
Chives, 827.
Chondrosia, 584.
Chondrotus, 88.
Chromatin, 17, 31, 150.
Chromulina, 139.
Chrysemys picta, 1126.
Chufa, 827.
Cichorium endivia L., 980.
Cicisbeo, 10.
Cilioflagellata, 487.
Cinosternum pennsylvanicum, 1127.
Circolo degle Aspiranti Naturalisti, 953.
Cistudo, sexual characters of, 88.
Cladistia, 1018.
Cladocera from Australia, 186.
Clarias, 190.
Clary, 828.
Claypole, E. W., sandstones of Pennsylvania, the four great, 1055.
the materials of the Appalachians, 956, 1055.
Claytonia perfoliata Don., 829.
Cobra bite, 394.
Coccosteidæ, 1019.
Coccosteus inflatus, 1019.
Coddling moth, 480.
Codosiga, 139.
Cœcilians, development of, 1035.
Cœlacanthidæ, 1018.
Cœlenterates, 390, 487, 673, 1033.
Cœlurus, 367.
bauri, 368.
longicollis, 368.
Cohen, E., andalusite in granite, 1112.
Cole, W. W., 302.
Collozoum, 17.
Collyrio, nesting of, 90.
Colonoceras, 994.
Color, nomenclature of, 166.
Colorado group, 449.
potato beetle in Europe, the, 1030.
Colton's Practical Zoology, 554.
Colymbetes, 20.
Comanche group, 447.
Comatula, 487.
Comparative chemistry of higher and lower plants, 719, 800.
Comstock, J. H., a new form of vial for alcoholic specimens, 771.
emergence of caddis fly from the water, 480.
joint-worm in New York, 381.
notes on the respiration of aquatic bugs, 577.
Congdon, Ernest A., crustaceans, 1045.
Congo expedition, German, 63.
exploration, 559.
region, 361.
Conjugation, 156, 221.
Conn, H. W., 404.
notice of Cope's Origin of the Fittest, 465.
scientific fact and scientific inference, 791.
Conodonts, 69.
Consciousness, seat of, 295.
Constant temperature apparatus, 597.
Conventionalism in ancient American art, 713.
Cope, E. D., American Association at New York, 833.
American committee of the International Congress of Geologists, 835.
American Triassic Rhynchocephalia, 468.
ancestry of ungulates by Pavlow, 656.
death of Spencer F. Baird, 836.
description of brain-case of Belodon buceros, 660.
evolution and idealism, 594.
hyoid bones in salamanders, 87.
International Congress of Geologists, 643.
Marsh on new fossil mammalia, 926.
new Tæniodonta from the Puerco, 469.
notice of Hill's Cretaceous of Texas, 469.
notice of Kedzie's Gravitation, Heat, and Sun-Spots, 465.
on Brazilian Reptilia, 388.
on nursing frogs, 310.
on the Dinosaurian, Cœlurus, 367.
on the formations of the Belly River of Canada, 171.
Origin of the Fittest, 465.
saber-tooth tiger from Loup Fork beds, 1019.
scientific theism, 951.
Scott and Osborn on White River Mammalia, 924.
Scott on Creodonta, 927.
sea-saurians of the Fox Hills Cretaceous, 563.
sex in government, 399.
synopsis of the flora of the Laramie group, 1011.
the Carboniferous genus Stereosternum, 1109.
the marsupial genus Chirox, 566.
the Mesozoic and Cænozoic realms of the interior of North America, 445.
the Perissodactyla, 985, 1060.
the pug-dog and the Chihuahua dog, 1125.
the relations of mind to matter, 1007.
the theory of evolution, 1127.

Cope, E. D., Thomas on Mammalian dentition, on, 1003.
Tropidonotus, new species, 1035.
vertebrate palæontology, 164.
Zittel's Manual of Palæontology, 1014, 1019.
Copper, 374.
Copulation, 221.
Coral reefs, 390.
mushroom, 386.
Corchorus olitorius L., 829.
Coriander, 830.
Coriandrum sativum, 830.
Corisa, 577.
Corn salad, 831.
Zea mays L., var. saccharata, 831.
Cornet, F. L., 304.
Cortland series, 568.
Cosmonetta histrionica, 488.
Costmary, 903.
Coulter, John M., correction of origin of Indiana flora, 1132.
Crabs, fiddler, 415.
Credner, studies of life-history of Stegocephali, 659.
Crepidula, organ of smell, 486.
Cress, 56, 903.
Cresson, E. T., synopsis of the Hymenoptera of America north of Mexico, 772.
Cretaceous of Texas, 469.
of New Jersey, 66.
Cretacic system, 447.
Crinoid beds at Crawfordsville, Indiana, 1106.
Crocidolite, 1023.
Crocker, Lucretia, scholarships, 684.
Crossopterygia, 1017.
Cross-timbers of Texas, 172.
Crozier, A. A., vitality of buried seeds, 666.
Crustacea, 673, 860.
development of, 293.
notes on, 194, 393, 488.
polar globules in, 203.
Crustacean eyes, preparation of, 401.
Crystallographic news, 275, 374, 663, 852.
Ctenidium of Unio aberti Conrad, 857.
Ctenodrilus parvulus, 669.
Cuchia, 190.
Cuckoo-flower, 905.
Cucumaria, 193.
spermatozoa, 22.
Cucumber, 906.
Cucumis sativus L., 906.
Culture cells, 478.
Cumin, 910.
Cuminum cyminum L., 910.
Cyanosoma, 193.
Cyathomonas, 139.
Cyclodipterini, 1018.
Cyclolepidoti, 1018.
Cymbium, parasite of, 199.
Cynara, 126, 525.
Cyperus esculentus L., 827.
Cystoblast, 146.
Cystophora antillarum, 263.
Cytenchyma, 38.
Cytodieresis, 144.
Cytology, 24.
Cytoplasm, 20, 31, 151.

Dæodon, 1063.
Dahl, Karl, the zoologist, entered upon duties at the University of Kiel, 790.
Dakota group, 448.
Dallingeria, 139, 220.
Dana, James D., voyage to the Hawaiian Islands, 789.
Dancus, 527.
Dandelion, 911.
Daphnia, 186.
Darwin, Charles, 405.
Datholite, 1024.
Davis, William Morris, entomological notes, 1045.
instruction in geological investigation, 810.
physical history of the Somerville (Mass.) slates, 1138.
Davis, W. T., secondary sexual characters in Cistudo, 88.
Dawson, J. W., 303.
Day, Francis, hybrid between pilchard and the herring, 103.
De Bary, A., of Strasburg, chair of botany in University of Leipzig, 790.
Deer, red, in Ireland, 188.
Deities of Navajos, 206.
Delamination, 342.
Dendræca maculosa, 1138.
Dendrobates, 307.
Dero, 391.
Descloizite (ramirite), 1023.
Desert pocket-rat, 42.
Deutoplasm, 38.
Development of an eight-limbed vertebrate, 862.
Devonian of Pyrenees, 369.
Diaphanosoma, 186.
Diapheromera femorata, 1138.
Dichelaspis, 488.
Didrichsen, D. F., professor of botany at Copenhagen, death, 790.
Dieulafait L., 106.
Dihoplus, 1000.
Dill, 911.
Dilophodon, 994.
Dinoflagellates, 487.
Dinosaurian genus Cœlurus, 367.
Diplacodon, 1063.
Diplarthra, 985.
Dipnoan brain, 544.
Dipnoi, 1018.
Dipodomys deserti, 42.
new species of, 42.
Dipterous larvæ in Sarracenia, 382.
parasite of silkworm, 482.
Direction corpuscles, 221.
Diseases of plants, 276.
Distribution of molluscs, 83.
Division of cells, 145.
Dodge, Thomas H., 303.
Dolichos, 132, 329.
Domestication of wild fowl, 778.
Douglas, var. scopulorum, 928.
Douglass, James, the Sonora earthquake, 1104.
Dragon Lake, 362.
Dwight, Thos., range of variation of the human shoulder-blade, 627.
Dwight on teleology of bone-structure, 774, 776.
Dwight, W. B., palæontological observations on Taconic of Canaan, N. Y., 270.
Dyaster, 150.
Dysodus pravus, 1126.

Eadie, E. M., on Diapheromera femorata, 1138.
Early man, Naulette jaw, 370.
Ears of insects, 579.
Earth-nut, 912.
Earth-worms, 391.
notes on, 193.
Eastward extension of Pinus ponderosa Douglas, var. scopulorum, 928.
Echidna, 490.
Echinoderm morphology, 289.
Echinoderms, 779.
intelligence of, 683.
notes on, 90, 193, 391, 487.
Echinorhynchi, anatomy of, 187.
Ecker, Alexander, anatomist and anthropologist of Freiburg, death, 790.
Ectocium, 1061.
Edwards, Chas. L., an expression of animal sympathy, 1129.
Egg, fertilization of, 221.
Eggers, Baron, 494.
Egg-plant, 975.
Eichler, Aug. Wilhelm, 493.
Eigenmann, Carl, study of Embiotocoid fishes, 790.
Elaphis, 585.
Elecampane, 980.
Electrolysis, 150.
Elephant spermatozoa, 21.

Elliot, Walter, death, 953.
Ellis and Everhart's Fungi, 379.
Embryology, 674.
Haddon's, 292.
Embryoscope, 297.
Encephalic vesicles, 940.
Enchylema, 31.
Encysted forms, vitality of, 485.
Endine, 980.
Endlichite, 374.
Endoplast, 154.
Endoplastule, 154.
England, Wales, and Ireland, 1076.
English bean, 981.
names for fungi, 264.
Enniskillen, Earl of, 302.
Entomological news, 580.
Entomophthoræ, 477.
Eocene system, 452.
cut by porphyrite, 471.
Eosinophil, 20.
Epihippus, 1061.
Epistylis, 220.
Equidæ, 993.
Equus beds, 458, 1073.
Eskimo, 133.
Essex Institute, at Salem, Mass., 688.
at last in possession of a home of its own, 789.
Ethnology, fourth report of Bureau of, 646.
of the Congo, notes on the, 689.
Euglypha, 18.
Eupagurus, spermatozoon, 23.
Evermann, B. W., rare Indiana birds, 291.
and Jordan, food-fishes of Indiana, 1034.
Evolution, the theory of, 1127.
and idealism, 594.
Exposition of insects, 580.
Eye-piece, micrometer, 477.
Eyes in Protozoa, 390.

Faba vulgaris Moench., 985.
Falkenburg, P., accepts chair of botany at University of Rostock, 790.
Farlow, W G., conception of species in cryptogamic botany, 1138.
Fassinite, 1113.
Faujasite crystals, 1112.
Fauna of Beaufort, 1125.
of German lakes, 386.
of Liverpool Bay, 581.
of Novaia Zemlia, 386.
Fayalite, 375.
Fecampia, 91.
Fecundation, 221.
Feeding pigs, experiments in, 396.
Fellowship in biology, Johns Hopkins University, 790.
Felsites of Pembrokeshire, 274.
Fennel, Roman, 59.
Fertilization of egg, 221.
of yucca, 484.
Fetterolf, George, on the rudimentary pineal eye of turtles, 1126.
Fewkes, J. Walter, 406.
new mode of life among Medusæ, 1000.
Fiddler-crabs, 415.
Fisher, A. K., Muhlenberg's tortoise, 672.
Spelerpes guttolineatus Holbrook, 672.
Tropidonotus clarkii, 672.
Fisher, G. A., 686.
Fishes, 91, 393, 489, 584, 673, 861, 946.
and reptiles from West Indies, 1035.
Flacherie, 383.
Fletcher, Planarians, 1034.
Flora of the Laramie group, synopsis, 1011.
of Cochin China, 953.
Pliocene, 467
Fly larvæ in Sarracenia, 382.
Fontaria brunnea, 82.
Food of the Amblystoma mexicana, 776.
fishes of Indiana, 1034.
Foraminifera, collecting, 584.
Forbes's address, The Lake as a Microcosm, 1044.
Forel, M. A., senses of insects, 1119.
Forficula, spermatozoon, 23.
Forman, E. S., sonnets, 354.
Formations of the Belly River of Canada, 171.
Formosa, 62.
Forsterite, 375.
Fossils of Canaan, N. Y., 270.
Fourth annual report of the Bureau of Ethnology, 646.
Fox Hills group, 449.
Frazer, Persifor, G. K. Gilbert's address before Section E, A. A. A. Science, Columbia College, N. Y., 841.
Freeman, L. W., arrow-heads, 1137.
Frenzel, John, of Berlin, now professor of zoology and director of the museum in Cordova, Argentine Republic, 953.
Fresh-water Crustacea, 670.
sponges, 1119.
Friedlander und Sohn, 303.
Fritillaria, 142.
Frogs, migrations of, 388.
Fruit pigeon, new, 583.
Fulac, A. M., worms, 860.
Fulgurites, 472.
Fungi of North America, 379.
English names for, 264.
upon their host-plants, 1114.
Fungia, structure of, 386.

Galanthus, 142.
Galeodes, larval, 486.
Galesaurus, 370.
Gamete, 38.
Gametogenesis, 38.
Gamsigradite, 473.
Ganong, W. F., is Littorina litorea indigenous or introduced? 287.
Garden vegetables, history of, 125, 321, 432, 520, 701, 826, 903, 975.
Garnet, 1113.
Gastræa theory, 344.
Gastrulation, 342.
Gatcombe, John, death, 953.
Gaule, Alice Leonard, method of staining and fixing, 677.
Geaster campestris, 1027.
delicatus, 1028.
Gelasimus, 415.
Gemminger, Max, death, 953.
Gemmules, 32.
Genera of North American Phalangiinæ, 935.
Generation, spontaneous, 26.
Genus Geaster, the, 1026.
Geography and travels, 61, 360, 558, 650.
Geological news, 567, 656.
Geology and lithology of Lake Superior, 654.
and palæontology, 654.
Gephyrea, anatomy, 193.
Germ-layers, Metschinkoff on, 334, 419.
Giant-cell, 17.
Giard, Alfred, called to Paris as master of normal school, 1133.
Giglioli cercopithecus, 1034.
Gilbert, G K., before Section E. A. A. A. S., Columbia College, 841.
Gill, T. N., on ribbon-fishes, 86.
Gilman, Henry, discovery of an ancient tomb near the holy sepulchre, Jerusalem, 865.
Ginglymodi, 1018.
Giraffa, 568.
Girard, Maurice, 106.
Glacial epoch, 460.
Agassiz, 361.
Guyot, 361.
Tyndall, 361.
White River, 251.
Glacial flow in Iowa, 758.
Glaciation of Pacific coast, 250.
Glacier Bay, 254.
Glacier, Muir, 255, 360.
Glands in the foot of nudibranch molluscs, 670.
Glaucophane, 471.
Glazier, Lake, 61.

Glyptodipterini, 1018.
Goebel, Karl, 302.
Gold-mines, Kimberley, 62.
Goniobasis, 86.
Gonolobus obliquus, 612.
Gonothyræa, 21.
Goode, G. B., 107.
Gooseberry, Cape, 55.
Gordius, 488.
Gottsche, C., 494.
Grackle, American, in England, 189.
Grantia, 485.
Granula, 38.
Graphite, 1113.
Grass, scurvy, 56.
Gravis, A., of Brussels, elected professor of botany at Lüttich, 790.
Gray, Robert, 686.
death, 953.
Great Lakes, origin of, 168.
Green River shales, 453.
Greenlanders, East, 133.
Greenstones of Cornwall, 274.
Grewink, G., death, 1044.
Grossularite crystals, 1113.
Ground cherry, 55.
Grovanite, 570.
Growing parts of Pinus, 178.
Growth, 29.
of Tulostoma mammosum, 665.
Guyot Glacier, 361.
Gymnosporangium, 277.

Haast, Julius von, death, 1044.
Haddon on segmental duct, 587.
Embryology, 292.
Haeckel, Ernst, 303.
Halcampa, 582.
Halecomorphi, 1018–1019.
Haliomma, 17.
Haller, Gustav, 106.
Halsted, B. D., on pollen-tubes of lobelia, 76.
Haltica ampelophaga, 484.
Hamilton, Planarians, 1034.
Hancock, J. L., relative weight of brains of birds and man, 389.
Hansen, Armaieer, whale-fishing, Bergen, Norway, 685.
Haplistia, 1018.
Hardman, Edward T., death, 953.
Harger, Oscar, death, 1133.
Harold, Edgar von, 106.
death of, 953
Hausmannite, 1114.
Hay, O P., habits of the massasauga, 211.
Hayden, Ferdinand V., death, 1135.
survey, 164
Hay's economic fungology, 552.
Head flattening, 98.
Heaviest brain, 389.
Helaletes, 994.
Helix, 143.
spermatozoa, 22.
Hellins, John, death, 953.
Hemiptera, respiration of, 577.
Henlandite, 1113.
Henrich's crystallography, 57.
Hepaticæ Americanæ, 1104.
Heptodon, 994.
Herbich, Franz, 602.
Herderite, 72.
Hering, C. W., 494.
Hornerden, C. H. van, 106.
Herpetocetus, 568.
Harvey, A. B., 494.
Hesperiphona, 92, 290.
Hessian fly in England, 384.
Hessite, 1026.
Heterocephalus, 586.
Heteromyenia 1119
Hill on Cretaceous of Texas, 469.
Hillocks of decomposition, 366.
Hindia, 584.
Hinsdale, L. F., Terias lisa, 548.
Hipparion, 568.
Hippidium, 1073.
Hippocampus, 111.
Hippotherium, 1069.
Hitchcock, Fanny R. M., homologies of Edestus 847.
osteology of Alosa sapidissima, 1032.
Hollick, Arthur, garnets from artesian well, 1137.
germinated lemon-pits, 1137.
Hollow spherulites, 70.
Holoptychiidæ, 1018.
Holotheriums, 193.
Homologies of the wing-veins of insects, 932.
of Edestus, 847.
Hornblende, 1114.
Hornless ruminants, 730, 885, 1076.
Horse parsley, 51.
Horsford, E. N., printing Zeisberger's Indian Dictionary, 788.
Hough, Walter, ethnology of the Congo, 689.
Howlite, 1022.
Hoya globulosa, 614.
Hoyt, B. F., tree-trunk and branches, 70.
Hulst, G D., 494.
Humboldt formation, 457.
Humming-birds, largest collections of, 90.
Hunt, T. S., on chemical integration, 474.
Taconic question restated, 114, 238, 312.
the Sonora earthquake, 1104.
Huth, Ernst, 303.
Hyaloplasm, 17, 31.
Hyalosiderite, 375.
Hyaster, 391.
Hyatt, A., on primitive forms of cephalopods, 64.
the values in classification of the stages of growth and decline, 1138.
Hybrid between pilchard and the herring, 1034.
Hydra, 487.
turning inside out, 387.
turning inside out,—a correction, 773.
Hydrodictyon, 18.
Hydromedusæ, history of, 387.
Hydrophilus, 141.
Hydropsyche, 480.
Hyoid bones in salamanders, 87.
Hyrachyus, 994–997.
Hyracodontidæ, 992–1000.
Hyracotherium, 994–996.

Ichthydium, 583.
Ichthyophis glutinosus, Sarasin on, 1035.
Ichthyosaurus, 567.
Idaho beds, 458.
Idioplasm, 32.
Igelstrom describes braunite and hausmannite, 1114.
Imbedding-baskets, 596.
apparatus, 101, 597.
Immortality of the personal consciousness, 400.
Incised boulders in the Upper Minnesota Valley, 619.
India, birds of, 189.
Indiana birds, 291.
flora, origin of, 1132.
University, 685.
Indices of anthropoid apes, 637.
Individual, 29.
Insectolophus, 994.
Insects and colored light, 383.
ears of, 579.
urinary organs of, 388.
Instruction, biological, 59.
biological, in universities, 507.
in geological investigation, 810.
Intelligence of rat, 295.
International Congress of Geologists, 643.
Inula hilenium L., 980.
Inversion of the germinal layers in Hesperomys, 863.
Irish marine faunæ, 856.
Isolated community in the Bahama Islands, 685.
Isopods, deep-sea, 288.
Isosoma hordei, 381.
Isospondyli, 1018–1019.

Jade, Chinese, in America, 96.
James, J. F., origin of Indiana flora, 1132.
origin of North American flora, 1009–1011.
the milkweeds, 605.
Janthænas, 583.
Japan, geology of, 363.
Japanese lavas, 70.
Jensen, O. S., death, 1133.
Jersey, geology of, 369.
Jeude, van Lidth de, fishes and reptiles from West Indies, 1035.
John Day group, 456.
Joint-worm in New York, 381.
Jordan and Evermann, food-fishes of Indiana, 1034.
Jordan's science sketches, 1103.
Journals, botanical, 79.
Julus ellipticus, 81.
burkei, 82.
Jurassic system, 446.

Kaliophyllite, 373.
Kaolin, 473, 1026.
Karyokinesis, 145, 149.
Karyolysis, 147.
Karyoplasm, 31.
Kaup, Chalicotherium, 1061.
Nestoritherium, 1061.
Kayak, 134.
Keep's west coast shells, 1012.
Kellogg, Albert, 602.
Kerchenpaur, G., 494.
Key to the recent family of sponges, 935.
Kickx, J. J., 602.
Kimberley gold-mines, 62.
Kingsley, J. S., accepted professorship of biology in Indiana University, 685.
arthropod eyes, 1120.
conventionalism in ancient American art, 713.
Kedzie's Gravitation, Solar Heat, and Sun-Spots, 464.
on development of spiders, by Kowalevsky and Schulgin, 201.
orientation for section cutting, 102.
science and duty, 922.
summer schools of biology, 747.
Klassen und Ordnungen des Thierreichs, Bronn, 685.
Klein, C., 601.
Klossia, 18.
Knäuel, 149.
Knox, Arthur Edward, 686.
Koninck, L. G. de, death, 1044.
Korschelt, E., assistant in zoological institute of the University of Berlin, 953.
Kræpelin, K., organs of smell in arthropods, 182.
Kurtodon, 1020.
Kynoblast, 426.

Laboratory notes, 477.
Labrets, 135.
Labyrinthula, 18.
Lack of parallelism between the characters of larvæ and adults, 1030.
Lacoste, C. M., van der Sande, 493.
Lake Glazier, 61.
Mistassini, 62.
Lambdotherium, 1061.
Land-slide at Brantford, Ont., 267.
Lang, John, British entomologist, death, 684.
Langbanite, 1021.
Langley, S., 107.
Language, universal, 462.
Laramie group, 450.
Larva in Sarracenia, 382.
Larval Galeodes, 486.
Lastarriæa, 278.
Laterite, 275.
Lathyrus tuberosus, L., 912.
Laubanite, 1021.
Lavas, Japanese, 70.
Length of rivers, 558.
Lenz's journey, 361.
Lepidium sativum L., 903.
Leptocephalus, 92.
Leptothrix, 1.
Lepus cuniculus in America, 265.
Leucophrys, 19.
Leurocephalus S. and O., 1061.
Lewis, T. H., incised boulders in the Upper Minnesota Valley, 639.
Leydig, Franz, 601.
Leydigia, 186.
Lichens, the study of, 666.
Lichtenstein, Jules, 494.
Lieberkuhn, Nathaniel, 686.
Liebsch, T. H., 601.
Lienard, V., 494.
Lima beans in germination, 576.
Limnohyus, 1061.
Linguælapsus, 88.
Linophryne, 584.
Liquid for preserving larvæ, 772.
Lithobius howei, 81.
minnesotæ, 81.
new, 81.
proridens, 81.
pullus, 81.
trilobus, 81.
Lithophysæ, 372.
Littorina litorea indigenous or introduced, 287.
cardinalis, 81.
Liuchu, history of, 99.
Liverpool Bay, fauna of, 581.
Lobelia pollen-tubes, 75.
Lockwood, S., more about the sea-horse, 111.
Locusta, spermatozoon, 23.
Logan, J. A., 107.
Lojka, Hugo, death, 1133.
Lophiodontidæ, 992.
Loup Fork group, 457.
Lower invertebrates, 945.
Loxodes, 19.
Loxophyllum, 19.
Lucasite, 72.
Ludwig, A., 601.
Hubert, called to Zoological Institute in Bonn, 788.
Lycopersicum, 575.
Lycopodium in Iowa, 572.
Lydekker's fossil mammals, 554.
description of *Scelidotherium chilense*, 660.
Lysopteri, 1018.

Machærodus catocopis, 1019.
Macraucheniidæ, 993.
Macropoma, 277.
Malpighian tubes of cockroach, 388.
Mammalia, development of, 394.
Mammals, 93, 585, 674, 861.
Man and mastodon, 404.
early, 370.
in Pliocene, 459.
races of, 204.
Manchuria, 561, 654.
Manipur, 562.
Manti beds, 454.
Manuals, botanical, 376.
Marcou, J. B., review of the progress of N. A. palæontology in 1886, 532.
Marine biological station at Nisaki by Imperial University of Japan, 1132.
Marion, A. F., corresponding member of the Department of Anatomy and Zoology of the Academy of Science, Paris, 1044.
Marsdenia tenacissima, 615.
Marsh on new fossil Mammalia, 926.
Marsupials, embryology of, 489.
Mason, O. T., Temple's classification of folk-lore, 590.
Massai Land, rocks of, 371.
Massasauga, habits of, 211.
Massige Gesteine, 172.
Massive rocks, texture of, 375.
Mastodon, 568.
Materials of the Appalachians, 1055.
Mather, Fred., domestication of wild fowl, 778.
a mink gnaws iron wire, 1124.

Mayer, Paul, microtechnical notes by, 1040.
Mayr, H., appointed professor of botany in University of Tokio, 1044.
McBride, T. H., a couple of botanical estrays, 572.
McCartee, D. B., history of Liuchiu, 99.
McMurrich, on sea-anemones, 1125.
Megalonyx beds, 459.
Meionite, 373.
Melissa, 321.
Memory in wasps, duration of, 1038.
Menodontidæ, 993.
Menodus, 1063.
Mentone, caves of, 370.
Merospondyli, 1018.
Merriam, C. H., a new species of Motoma, 191.
Mesminite, 570.
Mesodon, 84.
Mesohippus, 1067.
Mesozoic of North America, 445.
Metakinesis, 142, 151.
Metaphase, 142.
Metazoa, origin of, 334, 419.
Meteorites, 72, 570.
Method of photographing serial sections, 1130.
of staining and fixing the elements of blood, 677.
Methods of instruction in general geology, 616.
Metschnikoff on germ-layers, 334, 419.
Meyenia, 1119.
Michot, Norbert, death, 790.
Miclein filament, 17.
Microcosm, the lake as a, 1044.
Microlepidoti Zettel, 1018.
Micrometer, eye-piece, 477.
Microporus, 565.
Microscopy, 677.
Microsomata, 18, 31, 151.
Microtechnical notes, 1040.
Microtome, Ryder's, 298.
Micus, structure of, 71.
Middlesex Institute, 688.
Miers, E. J., 106.
Migration of the American magpie to Eastern Nebraska, 1122.
Milkweeds, the, 605.
Mills, T. Wesley, isolated community in the Bahama Islands, 685.
Mimetite, 1022.
Mimicry in arthropods, 185.
in caterpillar, 82.
Mimonectes, 185.
Mineralogical news, 373, 662, 850, 1109.
Mineralogy and petrography, 660, 1109.
Minerals, new, 1021.
Mink gnaws iron wire, 1124.
Miocene system, 455.
Mississippi, source of, 61.
Valley and the Great Lakes, 168.
Missouri River crow-roosts, 1121.
Mistassini Lake, 62.
Mitokinesis, 151.
Mitom, 151.
Mitosis, 151.
Mitsikuri, K., hydra turning inside out, 773.
Möbius, Karl, is called to Berlin as professor of zoology, 790.
Moina, 186.
Molluscan eyes, preparation of, 401.
Molluscs, distribution of, 83.
notes on, 194, 291, 392, 780.
of Lake Tanganyika, 288.
of the Challenger Expedition, 392.
organ of smell, 486.
primary organs of, 388.
Monachus tropicalis, 257.
Monas, 17.
Mongolia, 561.
Monotremata, embryology of, 489.
Moore, Thomas, 303.
Moresnet, 62.
Morgan, A. P., the genus Geaster, 1026, 1029.
Morphology and origin of the Ichthyopterygia, 837.
of ribs, 942.
Morphotropism, 375.
Mt. Lebanon region, geology of, 369.
Mt. Licancaur, 558.
Moulds, study of, 207.
Mouse, spermatozoa, 22.
Muir Glacier, 255, 360.
Murdoch, J., on East Greenlanders, 133
errors regarding Eskimo, 9.
Mushroom coral, structure of, 386.
Mycoderma, 2.
Myriapods and light perception, 384.
function of palpi, 384.
North American, 81.
notes on, 194, 946.
Mysis, development of, 293.
Myzostomata, Nansen's, 186.

Naples water-bath, 951.
National Academy of Sciences, the, 1046.
herbarium, the, 766.
Natural Science Association of Staten Island, 1045
Navajo head-flattening, 98.
deities of, 206.
Nelson, J., significance of sex, 16, 138, 216.
Neoceratodus, 544.
Neotoma bryanti, 191.
new species of, 191.
Nepeta cataria, 701.
Nephridia of invertebrates, 388.
Nephthys, 20.
Nesting of Collyrio, 90.
Nest-making by an ant, singular adaptation in, 770.
Nestoritherium, 1061.
Nettle-cells, 289.
New Britain group, 364.
New building for zoological museum, Berlin, completed, 684.
New Guinea, 365. 562.
New Hampshire Fish and Game Commission, 788.
New Jersey Cretaceous, 66.
New York Academy of Sciences, 688.
Niagara River, age of, 269.
Nias, 561.
Nightshade, Malabar, 322.
Nigrosinophil, 20.
Nimravus gomphodus, 1020.
Niobrara group, 448.
series, 457.
Noctiluca, 17.
Notonecta, 577.
Novaia Zemlia, fauna of, 386.
Nuclear figures, 16.
Nuclein, 31.
Nucleolus, 17, 31.
Nucleoplasm, 31, 35, 151.
Nursing in Dendrobates, 307.

Observations on the female form of Phengodes laticollis Horn, 853.
Ocimum, 324.
Odium antitheologicum, 356.
Oebbecke, K., 304.
Œnothera biennis L., 985.
Ogden, John T., 601.
Ohio Archæological and Historical Quarterly, 789.
Olfactory organs of arthropods, 182.
of insects, 279.
Oligocene, 456.
Oligoclase, 1114.
Olivene, 372.
Onychodactylus, 139.
Opalina, 38, 138.
Opheocephalus, 190.
Opuntia, 354.
Orcella, 189.
Orchid, 19.
Orchis, 220, 612.
Organs, 26.
of smell in insects, 279.
Orientation in imbedding, 10, 1102.
Origin of a small race of turkeys, 350.
of American love terms, 99.
of cave faunæ, 82.
of placental types and on certain vestigiary structures in the placentæ of the mouse, 780.

Origin of the Fittest, 465.
of the North American flora, 1009.
of tomato, 573.
Oris, 586.
Ornaments on pottery, 97.
Ornithorhynchus, 490.
Orophosaurus, 564.
Osborn, Henry F., relation of the dorsal commissures of the brain to the formation of the encephalic vesicles, 940.
Osborn, H L., 406.
Crustacea, 673.
Kurtodon, 1020.
Osphradium of Crepidula, 486.
Osteolepididæ, 1018.
Osteology of Aosa sapidissima, preliminary notes on the, 1032.
Oudemans, A. C., 106.
Oviposition in Dendrobates, 307.
Ovulists, 25.
Ovum, 39.
Oxytricha, 19, 135.

Pachynolopus, 1061.
Pacific coast glaciation, 250.
Packard, A. S., abstract of Hauser on organs of smell in insects, 279.
cave fauna, 82.
on Kraepelin's organs of smell in arthropods, 182.
Packard's fossil arthropods, 1100.
Palæoniscidæ, 1018.
Palæontology in America in 1886, 532.
Palæosyops, 1061.
Palæotheriidæ, 993, 1066.
Palæotherium, 1067.
crassum Cuv., 1067.
Palestine, rocks of, 372.
Palmer, E., on Mexican pottery, 97.
Palmer, T. C., birds roosting in town, 939.
Paloplotherium, 1067.
Palpi of spiders and myriapods, function of, 384.
Paludina, spermatozoa, 22, 23.
Pampean beds, 458.
Papua, 365.
Parachromatin, 151.
Paragonite, 1113.
Paramitom, 151.
Paramœcium, 139, 220.
Paranucleus, 19, 20, 40.
Parasitic bacteria, 1.
fungi, upon their host-plants, injuries produced, 1114.
rotifer, a, 1032.
sea-anemones, 582.
Parenchymella theory, 421.
Parmula, 1119.
Parnassia, 354.
Parthenogenesis, artificial, 484.
Patten, William, eyes of mollusks and arthropods, 1120.
Patton on hornblende, oligoclase, and titanite, 1114.
Patula, 84.
Pavlow on the ancestry of Ungulates, 656.
Pea, Halifax, 133.
Peachia, 582.
Pear chick, 709.
Peckham, G. W. and E. G., duration of memory in wasps, 1038.
Pedigree moths, 578.
Pelagic fauna of German lakes, 386.
Pelobates, 140.
Pelomyxa, 18.
Perception of space, 102.
Peridotite, 71.
Perissodactyla, the, 985, 1060.
Permian, 659.
Perognathus, 45.
Persh, Bernard, 600.
Personal consciousness, immortality of, 400.
Peruvian volcanic rocks, 273.
Petrographical news, 371, 471, 568, 660, 761, 848, 1109.
Petrography of Ponza Islands, 273.
of Spain, 471.
Phagocytella theory, 427.
Phagocytoblast, 426.
Phaseolus, 327.
Phenacite, 474.
Phengodini, 1118.
Philadelphia Academy of Sciences, 687.
Philomedusa, 582.
Philonthus, 184.
Phœnicopterus, 585.
Phoma, 277.
Phosphorescence in an earth-worm, 773.
Physa, 85.
Physalis, 53.
Physianthus, 501.
Physiology of plants, vines, 266.
Pierre group, 448.
Pig feeding, experiments in, 396.
Pigeon, spermatozoa, 22.
Pike, Nicolas, marine algæ, 1045.
Pilsbry, H. A., on Floridan Planorbes, 287.
Pimpinella, 58.
Pineal eye of Chelonians, the rudimentary, 1126.
Pinus strobus, growing parts of, 178.
Piptomerus hexagonus, 565.
megaloporus, 564.
Placodermi, 1019.
Placula theory, 347.
Plagiotoma, 19.
Planarians, 1034.
Planeropleuridæ, 1018.
Planorbes of Florida, 286.
Planorbis, 286.
Plant diseases, 276.
Plantago, 442.
Planting buckthorn, 442.
Planula theory, 346.
Plasmodia, 221.
Plasmosoma, 20.
Plasmosomata, 31.
Plastin, 152.
Platysomidæ, 1018.
Pleomorphs of quartz after fluorite, 473.
Plesiosaurus, 564.
Pleurocera, 86.
Pliocene flora, 467.
system, 45.
Pliolophus, 994.
Plistocene system, 459.
Plotus anhinga, 291.
Plotz, Karl, 106.
Plumatella, 186.
Pocket-rat, 42.
Podopterygia, 1017.
Poisonous sea-urchin, 193.
Pokorny, A., 493.
Polar corpuscle, 48.
globules in Crustacea, 203.
Polistes, 183.
Poljakow, J. S., St. Petersburg, died, 684.
Pollen, François G. L., 686.
Pollen-tubes of lobelia, 75.
Polycotylus, 564.
Polycricus, 138.
Polygyra, 85.
Polymastodon, 567.
Polypteridæ, 1018.
Polyspermy, 221.
Polytoma, 139.
Pomatomus, parasite of, 195.
Ponza Islands, petrography of, 273.
Pop-vine, 54.
Porphyrite cutting Eocene, 471.
Portchinski on flies which in their larvæ stage cause diseases among men and animals, observations of, 1029.
Postcretacic system, 450.
Postpliocene, the discovery at Spy of two human individuals, allied to those found at Canstadt and Neanderthal, 660.
Potamolepis, 1119.
Poterium, 443.
Pottery, Mexican, 97.

Potts, Edw., fresh-water sponges, 1119.
Practical Botany, Strasburger and Hillhouse's, 357.
Prejevalsky's explorations, 652.
Preparation of mollusc eyes, 401.
Priapulidæ, 193.
Prickly pear, 354.
Primrose, evening, 985.
Proceedings of scientific societies, 687.
of the American Society of Microscopists, 645.
Prochromatin, 151.
Progress of arachnology in America, 963.
Prophase, 142.
Proplacula, 347.
Protapirinæ, 994.
Protapirus, 994.
Prothyalosome, 20.
Protohippus, 1068.
Protospongia, 419.
Protozoa, eyes in, 390.
cell-division in, 153.
notes on, 389, 487, 584.
Proventuria, 277.
Pseudochirus, 586.
Pseudoscorpions, anatomy of, 583.
Psittacotherium megalodus, 469.
multifragum, 469.
Psychology, 683.
Pteraspididæ, 1019.
Pterichthyidæ, 1019.
Pterolite, 473.
Puerco group, 450.
Tæniodonta, 469.
Pug-dog and Chihuahua dog, the, 1125.
Pupa, 85
Pycnodontidæ, 1018.
Pyrenees, geology of, 369.
Pyroxene, 1025.
Pyrrhotite, 1026.

Rabbit, spermatozoa, 22.
Rabbits, Australian, in America, 265.
Races of men, 204.
Radiolaria, 668.
Raja, spermatozoa, 22.
Rana, 21.
Randolph, N. Archer, death, 869.
Range of variation of the human shoulder-blade, 627.
Ranvier, L., 303.
Rare Indiana birds, 291.
Rat, 143.
intelligence of, 295.
spermatozoa, 21.
Rathbun, Richard, Cœlenterates, 1033.
Rattlesnake, prairie, 211.
Raymond, Jas., fish-hawk, 1138.
Recent investigations of American minerals, 1021.
publications, 1030.
Red deer of Ireland, 188.
Reduction of chromic solutions in animal tissues, 868.
Regalecus, 86.
Reiss and Steubel's Necropolis of Ancon, Peru, translation completed, 953.
Rejuvenescence, 29.
Relation of the dorsal commissures of the brain to the formation of the encephalic vesicles, 940.
Relations of mind to matter, the, 1007.
Report U. S Fish Commission, 555.
Reptiles of Brazil, 388.
Reptilia, 861.
and Batrachia, 673.
notes on, 393, 489, 585.
Respiration of aquatic bugs, 577.
Rhinoceridæ, 992.
Rhinoceros, 189.
Rhipidistia, 1017.
Rhipidopterygia, 1017.
Rhynchobothrium, 195.
Rhynchocephalia, American, 467.
Rhynchodontidæ Zitt., 1019.
Ribbon-fishes, 86.
Rice, William North, Stizostedium vitreum in the basin of the Connecticut, 938.
Richardson, E. L., ants and sunflowers, 297.
Ridgway's Manual of Ornithology, 1011.
Nomenclature of Colors, 166.
Rink's paper on the East Greenlanders, 749.
Rinne, faujasite, 1112.
Rivers, F F., Phengodini, 1118.
Rivers, length of, 558.
Rock terraces in Sweden, 69.
Rœstelia, 277.
Roman fennel, 59.
Rominger, Prof., and the Michigan Geological Survey, 551.
Rosenbusch's Massige Gesteine, 172.
Rotifers, development of, 93.
Ruined cities of Yucatan, 787.
Rulstonite, analysis, 72.
Rutile, 1025.
Rutley, on structure of Malvern Hills, 1111.
Ryder, J. A., development of an eight-limbed vertebrate, 862.
inversion of the germinal layers in Hesperomys, 863.
new imbedding apparatus, 597.
origin of placental types and on certain vestigiary structures in the placentæ of the mouse, rat, and field-mouse, 780–784.
the vestiges of a zonary decidua in the mouse, 1037.
Ryder's microtome, 298.

Saber-tooth tiger from Loup Fork beds, 1019.
Saccharomyces, 2.
Saccobranchus, 190.
Sacculi of Crinoids, 289.
Safranophil, 20.
Sagartia gracillima, 1125.
pustulata, 1125.
Salamander, 19, 141.
spermatozoa, 21.
hyoid bones in, 87.
Samarskite, 1024.
Sampson, F. A., distribution of shells, 83.
Sand boulders in the drift, or subaqueous origin of the drift, in Central Missouri, 917.
Sandberger, origin of graphite, 1113.
Sandstones of Pennsylvania, the four great, 1055.
Sanford, E., on the growing parts of white pine, 182.
Saprophytes, 1.
Sarasin, development of the Cœcilians, 1035.
Sarcolite, 373.
Saurians of the Fox Hills Cretaceous, 563.
Saurodontidæ, 1019.
Sauropsidæ, 1018.
Scapolite, 373.
Schauinsland, H., goes to Bremen, 783.
Schizomycites of Encyclopædia Britannica, 77.
Schödler, J. E., 494.
Scholarships Lucretia Crocker, 684.
Schultze's method of preparing the amphibian egg, 595.
Science and duty, 922.
Science in Sweden, 409.
Scientific Theism, 951.
Scolecophagus ferrugineus in England, 189.
Scolioplanes ruber, 81.
Scorodite, 1025.
Scorpion, development of, 140, 201.
Scorpiurus, 701.
Scott and Osborn, on White River Mammalia, 924.
on Creodonta, 927.
Scurvy-grass, 56.
Scymnus, 546.
Sea-anemones, parasitic, 582.
Sea-cow (Rytina) exterminated, 1047.
Sea-horse, 111.
Sea-serpent, 463.
Sea-urchin, poisonous, 193.
Section-smoother, 597.
Segmental duct, epiblastic origin of, 587.
in elasmobranchs, origin of, 1037.
Selachii, 1019.

Sense-organs of arthropods, 182.
Crepidula, 486.
of insects, 279.
of Turbellarians, 1031.
of sponges, 485.
Senses of myriapods, 384.
of insects, 579, 1119.
Serpent mound, 786.
Serpentine, 569.
Sesarma, the genus, 1032.
Sex, significance of, 16, 138, 211.
in government, 399.
Sexual cells, 38.
characters in Cistudo, 88.
Seymour, A. B., injuries produced by parasitic fungi upon their host, 1114.
Shrike, loggerhead, 90.
Shufeldt, R. W., 303, 601.
anatomy of the auks, 777.
arrow-release among the Navajos, 784.
turkey skull, the, 777.
Siderite, sphærosiderite, 1024.
Significance of sex, 16, 138, 211.
Silk-worm diseases, 482.
Smell, organs of, in arthropods, 182.
in insects, 279.
Smilodon fatalis Leidy, 1020.
Smith, H. W., on nursing and oviposition in the batrachian genus Dendrobates, 307.
Smith, J. B., 494.
Smith, T., Bacteria, 1.
Smut in oats, 475.
Smyrnium, 51.
Snake-bird, 291.
Snowy owl, 290.
Solanum melongena L., 975.
Solpuga, 486.
Sonnets, 354.
Sonora earthquake of May 3, 1887, 1104.
Source of Mississippi, 61.
Space perception, 162.
Spain, 562.
Sparrow, spermatozoa, 22.
Spelerpes guttolineatus Holbrook, in the vicinity of Washington, D. C., 672.
Spencer, J. W., hillocks and boulders of decomposition in Missouri, 366.
landslide at Brantford, Ontario, 267.
sand-boulders in the drift, or subaqueous origin of the drift in Central Missouri, 917.
warping of the earth's crust in relation to the great lakes, 168.
Spencer, W. Baldwin, 208.
describes structure of the pineal eye in Lacertilia, 1126.
Spengel, J. G., called to Geissen, 788.
Spengel, W., 601.
Spermatid, 21.
Spermatists, 25.
Spermatocytes, 41.
Spermatogenesis in Mammalia, 946.
Spermatozoa, development of, 21, 41.
Sphærechinus, 220.
Sphærodontidæ, 1019.
Sphærozoum, 18.
Spherulites, hollow, 70.
Sphex, 183.
Sphyranura, 194.
Spiders, development of, 294, 674.
function of palpi, 384.
Spirem, 151.
Spirochona, 139.
Spirogyra, 141.
Sponges, notes on, 291, 390, 584.
sense-organs, 485.
systematic position of, 581.
Spongilla, 193, 1119.
Spontaneous generation, 26.
Stapelia asterias, 613.
Starfish with rudimentary stalk, 391.
Stearns, R. E. C., Araujia albens as a moth-trap, 501.
Steatornis, 585.
Stejneger, L., new species of fruit pigeon, 583.
Stejneger, L., sea-cow (Rytina), exterminated, 1047.
Stenobothrus, spermatozoon, 23.
Stenotic division, 152.
Stenotrema, 84.
Stentor, 17, 19.
Stephens, F., new species of Dipodomys, 42.
Sternberg, C. H., on yellow fever bacilli culture, 1133.
Stizostedium vitreum in the Connecticut, 938.
Stomatopoda of the Challenger Expedition, 393.
Strata and thrusts, 267.
Strawberry tomato, 53.
Students as collectors, 477.
Studer, Bernard, death, 953.
Study of moulds, 207.
of plant diseases, 276.
Sturtevant, E. L., history of garden vegetables, 321, 433, 520, 701, 826, 903, 975.
Stylodontidæ, 1019.
Stylonychia, 139.
Stylorhynchus, 18.
Sumatra, 561.
Summer schools and universities, 747.
Sunflowers and ants, 295.
Sweden, science in, 409.
Symborodon, 1063.
trigonocerus, 1066.
Synagodus retusus, 1125.
mansuetus, Cope, 1126.
Syncitium, 18.
Synergid, 220.
Synocils, 485.
Synoicus, 291.
Synopsis of the Hymenoptera of America north of Mexico, 772.
Synthesis of carbonates, 475.
Systemodon, 993.

Taconic palæontology, 270.
question restated, 114.
system, 238, 312.
Tæniodonta from the Puerco, 469.
Tæniosomi characterized, 86.
Tantalite, 1026.
Tapalpite, 1023.
Taphozous, 189.
Tapiridæ, 992.
Tapirus, 189.
Taraxacum officinale, 911.
Taxistia, 018.
Taylor, W. Edgar, migration of the American magpie to Eastern Nebraska, 1122.
Missouri River crow-roosts, 1123.
Teall, J. J., hornblende rocks, 660.
Teeth of Vertebrata, 463.
Temporary mounting, 478.
Tenney, S. G., nesting of Collyrio, 90.
Tenore, Vinçenzio, 493.
Terias lisa, 548.
Terquem, Olny, death, 1044.
Tertiary, 660.
Test, J. H., the glands in the foot of nudibranch molluscs, 670.
Testudinata morphogeny of Carapace, 89.
Tetrarhynchobothrium, 199.
Texas, Cretaceous of, 469.
Cross-timbers of, 172.
Thalassicolla, 18.
Thirty-sixth Meeting of A. A. A. Science, 869.
Thomas on mammalian dentition, 1101.
Thompson, E. H., ruined cities of Yucatan, 787.
Thompson, Elizabeth, fund, 686.
Thrusts and strata, 267.
Ticholeptus beds, 456.
Tissues, 26.
Titanite, 1114.
Tomato, cherry, 55.
origin of, 573.
rot, 380.
strawberry, 53.
Tomb near the Holy Sepulchre, Jerusalem, discovery of an ancient, 865.
Tongue of humming-birds, 941.

Topaz, 1025.
electric axis of, 276.
Tortoise, Muhlenberg's, 672.
Tory, Ch., crystals of albite, 1114.
Tourmaline, thermo-electrical characters, 275.
Townsend, Charles H., teratology of the antlers of Cariacus columbianus, 1034.
Toxopneustes, 21.
Trachelocerca, 17.
Trachypterus, 86.
Tradescantia, 141.
Traill, William, 686.
Traube, H., on barite, 1114.
the mineralogist, has entered upon his duties at University of Kiel, 790.
Treat, Mary, Argiope riparia, var. multiconcha, 1122.
Tree-trunk and branches, 70.
Trias, 659.
Triassic system, 446.
Trichoplax, 349.
Triodopsis, 84.
Triplopodidæ, 992.
Tristichopteridæ, 1018.
Triton, spermatozoa, 22.
Trois, Henri, liquid for preserving larvæ, 772.
Tropidonotus, 489.
bisectus Cope, 1035.
clarkii B. G., in Southern Louisiana, 672.
Trouessart's microbes, ferments, and moulds, 551.
Truckee beds, 456, 458.
True, F. W., a new bat, Vespertilio longicrus, 1034.
Trybom, F., present condition of natural sciences in Sweden, 409.
Tubella, 1119,
Tunicates, notes on, 90, 393.
Turkey-skull, 777.
Turkeys, origin of a small race of, 350.
Tylophora asthmatica, 615.
Tyndale Glacier, 361.
Typothorax, 468.

Ugimya sericaria, 482.
Uinta group, 454.
Ulexite, 1024.
Ullmanite, 1113.
Underwood, Lucian M., progress of arachnology in America, 963.
Universal language, 462.
University instruction in biology, 507.
Unnatural history, 549.
Urinary organs of invertebrates, 388.
Uronautes, 564.
Urostyla, 19.
Uruguaya, 1119.
U. S. Fish Commissioner's report for 1883, 555.
U. S. Geological Survey, report of the, 1099.
Ustilago, 475.

Valerian, African, 50.
Valerianella olitoria Moench., 831.
Vanadinite, 374, 1022.
Vegetable pathology, 277.
Vegetables, garden, history of, 125, 321, 432, 520.
Vermes, notes on, 91, 193, 291, 391, 487.
Vertebrata, teeth of, 463.
classification of, 913.
Vertebrates, 1034.
Vespertilio longicrus, a new bat, 1034.
Vetch, Chickling, 710.
Vial for alcoholic specimens, a new form, 771.
Vicia faba L., 981.
Villarsite, 473.
Vine's Physiology of Plants, 266.
Vines, S. H., 405.
Vitality of buried seeds, 666.
of Cladoceria eggs, 186.
of encysted forms, 485.
Vivisection, illustrations of, 1013.
Vöchting, A., chair of botany in Tübingen, 1044.
Volcanic bombs, 271.
minerals of Peru, 273.
rocks of Fife, 274.
Volken's privat-docent in botany at Berlin, 1044.
Von Lendenfeld on sponges, 856.
Vorticella, 17, 19, 140, 219.
Vulpian, F. A., death, 953.

Wadsworth, M. E., director of Michigan Mining School, 1044.
Wagner, Moritz, death, 953.
Ward, H. L., life-history of Monachus tropicalis, the West Indian seal, 257.
Warping of earth and its relations to great lakes, 168.
Wasatch group, 453.
Washakie group, 454.
Websky, Martin, 303.
Webskyite, 1021.
Webster, Clement L., on the glacial flow in Iowa, 758–760.
Weed, Clarence M., genera of North American Phalangiinæ, 935.
homologies of the wing veins of insects, 932.
on Dipterous larvæ in Sarracenia purpurea, 382.
Weight of brain of birds, 389.
Weinkauf, H. C., 106.
Werneburg, A., 494.
West Indian seal, 257.
Western grebe, 291.
Westward extension of the black walnut, 929.
Whale-fishing, Bergen, Norway, Armauer Hansen, 685.
Wheaton, John M., 686.
White pine, growing parts of, 182.
River group, 455.
Whitfield, R. P., New Jersey Cretaceous, 66.
Whitman, C. O., 404.
biological instruction in universities, 507.
Wilder, B. G., brain of Ceratodus, 545.
classification of Vertebrata, 913.
Willemite, 475, 1023.
Williams, H. S., methods of instruction in general geology, 616.
Wilson, E. B., on the study of moulds, 207.
Wilson, H. V., translation of Metschnikoff on germ-layers, 334, 419.
Wilson, Thomas, death, 953.
Winchell, N. H., classification and nomenclature for the American Committee of International Geological Congress, notes on, 693.
Winchell's Elements of Geology, 571.
Wind River group, 453.
Winter cress, 56.
Witch-hazel, 354.
Wolle's Fresh-Water Algæ of the United States, 923.
Wood-rat, new, 191.
Woodward, Henry, 302.
Worms, 673, 779, 860, 1034.
Worthen, A. H., Carboniferous fishes, 1044.
Wortman's Teeth of Vertebrata, 463.
Wright, G. F., on glaciation of Pacific coast, 250.
Wright, J. M., fiddler-crabs, 415.
Wright, R. R., 107.
on Argulus and mortality of fishes, 188.

Yellow cells, 18.
fever bacillus culture, 1133.
Youmans, E. L., 304.
Yucca, fertilization of, 484.

Zeisberger's Indian dictionary, printing, 788.
Zelinska, C., batrachian teratology, 1034.
Zincite, 475.
Zircon, 372.
Zittel's Manual of Palæontology, 1014, 1019.
Zoff, W., University of Halle, 953.
Zonary decidua in the mouse, the vestiges of a, 1037.
Zonites, 85.
Zoological news, 673, 779.
Zoology of Burmah, 189.
Zygosis, 221.
Zymogen granules, 20.

. 1887. Vol. XXI., No. 7.

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CONTENTS:

PAGE

I MILKWEEDS. [Illustrated.] *Joseph F.* *Times* 605

THODS OF INSTRUCTION IN GENERAL GEOLOGY. *I. S. Williams* 616

E RANGE OF VARIATION OF THE HUMAN OULDER-BLADE. [Illustrated.] *Thomas ight* 627

ED BOULDERS IN THE UPPER MINNESOTA ALLEY. [Illustrated.] *T. H. Lewis* 639

TORS' TABLE.

he International Congress of Geologists 643

ENT LITERATURE.

roceedings of the American Society of Microscopists. 645
he Fourth Report of the Bureau of Ethnology . . 646
eal's Grasses of North America 647
ecent Books and Pamphlets 648

ERAL NOTES.

Geography and Travels.—General.—America.—frica.—Asia 650

Geology and Palæontology.—Notes on the Geology d Lithology of Lake Superior [Illustrated].—aylow on the Ancestry of Ungulates.—Geological ews 654

PAGE

Mineralogy and Petrography. — Petrographical News. — Mineralogical News. — Crystallographic News.—Miscellaneous 660

Botany.—The Growth of *Tulostoma mammosum.*—Ash-Rust again.—Vitality of Buried Seeds.—The Study of Lichens.—Botanical News 665

Zoology. — Radiolaria. — *Clenodrilus parvulus.*—Balanoglossus Larvæ.—The Glands in the Foot of Nudibranch Molluscs.—Fresh-Water Crustacea.—*Tropidonotus clarkii* B. G., in Southern Louisiana.—*Spelerpes guttolineatus* Holbrook, in the Vicinity of Washington, D. C.—Muhlenberg's Tortoise (*Chelopus muhlenbergii* Schweigger), at Lake George, N. Y.—Zoological News 668

Embryology.—The Development of Spiders . . . 674

Microscopy.—Method of Staining and Fixing the Elements of Blood 677

Psychology.—Intelligence of Echinoderms . . . 683

SCIENTIFIC NEWS 684

PROCEEDINGS OF SCIENTIFIC SOCIETIES 687

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CONTENTS:

PAGE

NOTES ON THE ETHNOLOGY OF THE CONGO. *Walter Hough* 689

NOTES ON CLASSIFICATION AND NOMENCLATURE FOR THE AMERICAN COMMITTEE OF THE INTERNATIONAL GEOLOGICAL CONGRESS, MARCH, 1887. *N. H. Winchell* 693

HISTORY OF GARDEN VEGETABLES (continued). *E. Lewis Sturtevant* 701

CONVENTIONALISM IN ANCIENT AMERICAN ART. [**Illustrated.**] *J. S. Kingsley* 713

COMPARATIVE CHEMISTRY OF HIGHER AND LOWER PLANTS. [**Illustrated.**] *Helen C. DeS. Abbott* 719

HORNLESS RUMINANTS. [**Illustrated.**] *R. C. Auld* 730

EDITORS' TABLE.

Summer Schools and Universities 747

RECENT LITERATURE.

Review of Dr. H. Rink's Paper on the East Greenlanders 748
Recent Books and Pamphlets 756

GENERAL NOTES.

Geology and Palæontology.—On the Glacial Flow in Iowa 758

Mineralogy and Petrography. — Petrographic News. — Mineralogical News. — Crystallographic News.—Miscellaneous 5

Botany.—The National Herbarium.—A Duty Botanists.—The Element of Time in Botanical Stud —Botanical News 7

Entomology. — Singular Adaptation in Nes Making by an Ant, *Cremastogaster lineolata* Sa [**Illustrated**].—A New Form of Vial for Alcohol Specimens [**Illustrated**].—Synopsis of the H menoptera of America North of Mexico.—Liquid f Preserving Larvæ 9

Zoology.—Turning Hydra inside out; a Corre tion.—A Remarkable Case of Phosphorescence p an Earth-Worm. — Dwight on the Teleology Bone-Structure.—Note on the Fossil of *Amblyotom mexicanum*.—The Turkey-Skull.—Anatomy of th Auks.—Domestication of Wild Fowl.—Zoologic News 9

Embryology.—A Theory of the Origin of Placer tal Types, and on certain Vestigiary Structures the Placenta of the Mouse, Rat, and Field-Mous [**Illustrated**] 9

Anthropology.—Arrow-Release among the Nava jos. — The Great Serpent-Mound. — The Ruine Cities of Yucatan 9

SCIENTIFIC NEWS 9

PROCEEDINGS OF SCIENTIFIC SOCIETIES 9

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CONTENTS:

PAGE

SCIENTIFIC FACT AND SCIENTIFIC INFERENCE. *H. W. Conn* 791

COMPARATIVE CHEMISTRY OF HIGHER AND LOWER PLANTS (concluded). **[Illustrated.]** *Helen C. DeS. Abbott* 800

INSTRUCTION IN GEOLOGICAL INVESTIGATION. **[Illustrated.]** *William Morris Davis* 810

HISTORY OF GARDEN VEGETABLES (continued). *E. Lewis Sturtevant* 826

EDITORS' TABLE.

The American Association at New York 833

The American Committee of the International Congress of Geologists 835

The Death of Professor Baird 836

GENERAL NOTES.

Geology and Palæontology.—On the Morphology and Origin of the Ichthyopterygia.—The Address of Vice-President G. K. Gilbert before Section E, A. A. A. S., Columbia College, New York, August 10, 1887.—On the Homologies of Edestus 837

Mineralogy and Petrography. — Petrographic News. — Mineralogical News. — Crystallograph News.—Miscellaneous 3

Entomology.—Observations on the Female For of *Phengodes laticollis* Horn. **[Illustrated]**. . 3

Zoology.—The Irish Marine Fauna.—Von Læ denfeld on Sponges.—Notes on the Ctenidium *Unio aberti* Conrad **[Illustrated]**.—Zoologic News 3

Embryology.—The Development of an Eigh limbed Vertebrate.—The Inversion of the Germin Layers in Hesperomys **[Illustrated]** 3

Anthropology. — The Discovery of an Ancie Tomb near the Holy Sepulchre, Jerusalem . . 3

Microscopy.—**Albuminized-Felt Tablets for Mou** ing Anatomical Preparations.—**The Reduction** Chromic Solutions in Animal Tissues corrected Reoxidation with H_2O_2 3

SCIENTIFIC NEWS 3

PROCEEDINGS OF SCIENTIFIC SOCIETIES 3

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CONTENTS:

PAGE

THE STUDY OF A SMALL AND ISOLATED COMMUNITY IN THE BAHAMA ISLANDS. *T. Wesley Mills* . . . 875

HORNLESS RUMINANTS (continued). [**Illustrated.**] *R. C. Auld* 885

HISTORY OF GARDEN VEGETABLES (continued). *E. Lewis Sturtevant* 903

REMARKS ON CLASSIFICATION OF VERTEBRATA. *Burt G. Wilder* 913

SAND BOULDERS IN THE DRIFT, OR SUBAQUEOUS ORIGIN OF THE DRIFT, IN CENTRAL MISSOURI. [**Illustrated.**] *J. W. Spencer* 917

EDITORS' TABLE.

Science and Duty 922

RECENT LITERATURE.

Wolle's Fresh-Water Algæ of the United States . . 923

GENERAL NOTES.

Geology and Palæontology.—Scott and Osborn on White River Mammalia.—Marsh on New Fossil Mammalia.—Scott on Creodonta 924

PAGE

Botany.—The Eastward Extension of *Pinus ponderosa* Douglas, var. *scopulorum*.—The Westward Extension of the Black Walnut.—The Iron-Wood Tree in the Black Hills.—Still another Tumble-Weed.—Botany in the A. A. A. S.—Botanical News . . . 9

Entomology.—On the Homologies of the Wing-Veins of Insects.—The Genera of North American Phalangiinæ 9

Zoology.—Key to the Recent Families of Sponges.—Occurrence of *Stizostedium vitreum* in the Basin of the Connecticut.—Birds Roosting in a Town.—The Relation of the Dorsal Commissures of the Brain to the Formation of the Encephalic Vesicles [**Illustrated**].—The Tongue of Humming-Birds.—On the Morphology of Ribs.—Zoological News . 9

Embryology.—Spermatogenesis in Mammalia 9

Psychology.—Scientific Theism 9

Microscopy.—The Naples Water-Bath. [**Illustrated.**] 9

SCIENTIFIC NEWS 9

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CONTENTS:

PAGE

THE MATERIALS OF THE APPALACHIANS. [Illustrated.] *E. W. Claypole* 955

THE PROGRESS OF ARACHNOLOGY IN AMERICA. *Lucien M. Underwood* 963

HISTORY OF GARDEN VEGETABLES (continued). *E. Lewis Sturtevant* 975

THE PERISSODACTYLA. [Illustrated.] *E. D. Cope* 985

EDITORS' TABLE.
The Relations of Mind to Matter 1007
Whitman's Journal of Morphology 1008

RECENT LITERATURE.
The Origin of the North American Flora 1009
Ridgway's Manual of Ornithology 1011
Synopsis of the Flora of the Laramie Group . . . 1011
Keep's West Coast Shells 1012
Batrachians and Reptiles of Central America and Mexico 1012
Illustrations of Vivisection 1013
Recent Books and Pamphlets 1014

GENERAL NOTES.
Geology and Palæontology.—Zittel's Manual of Palæontology [Illustrated].—A Saber-tooth Tiger from the Loup Fork Beds.—Note upon the Genus *Athrodon* 1014

PAGE

Mineralogy and Petrography.—New Minerals.—Recent Investigations of American Minerals . . . 1021

Botany.—The Genus *Geaster* [Illustrated] . . 1021

Entomology.—Observations of Portchinski on Flies which, in their Larva Stage, cause Diseases among Men and Animals.—Lack of Parallelism between the Characters of Larvæ and Adults.—The Colorado Potato-Beetle in Europe.—Recent Publications 1022

Zoology.—Sense Organs of Turbellarians.—A Parasitic Rotifer.—The Genus *Sesarma.*—Preliminary Notes on the Osteology of *Alosa sapidissima.*—Zoological News 1025

Embryology.—Development of the Cœcilians (*Ichthyophis glutinosus*).—The Origin of the Segmental Duct in Elasmobranchs.—The Vestiges of a Zonary Decidua in the Mouse 1027

Psychology.—On Duration of Memory in Wasps. 1027

Microscopy.—Microtechnical Notes by Dr. Paul Mayer [Illustrated] 1028

SCIENTIFIC NEWS 1029

PROCEEDINGS OF SCIENTIFIC SOCIETIES 1029

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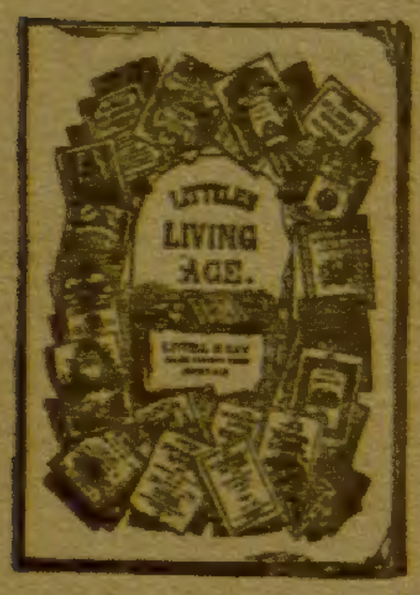

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